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Engineering Library

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Engineering Library

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Prof. J. J. Thomson

STUDENTS of physics will recognize at once the name of this brilliant English physicist, who, since 1918, has been Master of the famous Trinity College at Cambridge, England. Professor Thomson's early work in the realm of physics, especially in connection with electricity and magnetism, is too well known to be dealt with at length here, but his more recent work on the structure of matter is worthy of mention. At the first of a series of Founders' Memorial Lectures, delivered at Girton College in the early part of 1928, he gave a lecture entitled "Beyond the Electron," which has recently been issued in book form under the same title, and has received a hearty welcome. In this work, Professor Thomson points out that he does not consider the electron as being the ultimate form of matter, but as only another stepping stone in the vast subject of atomic physics. His views are of special interest to those who have followed the lucid articles on the de Broglie and Schrödinger atomic concept presented in recent issues of this magazine.

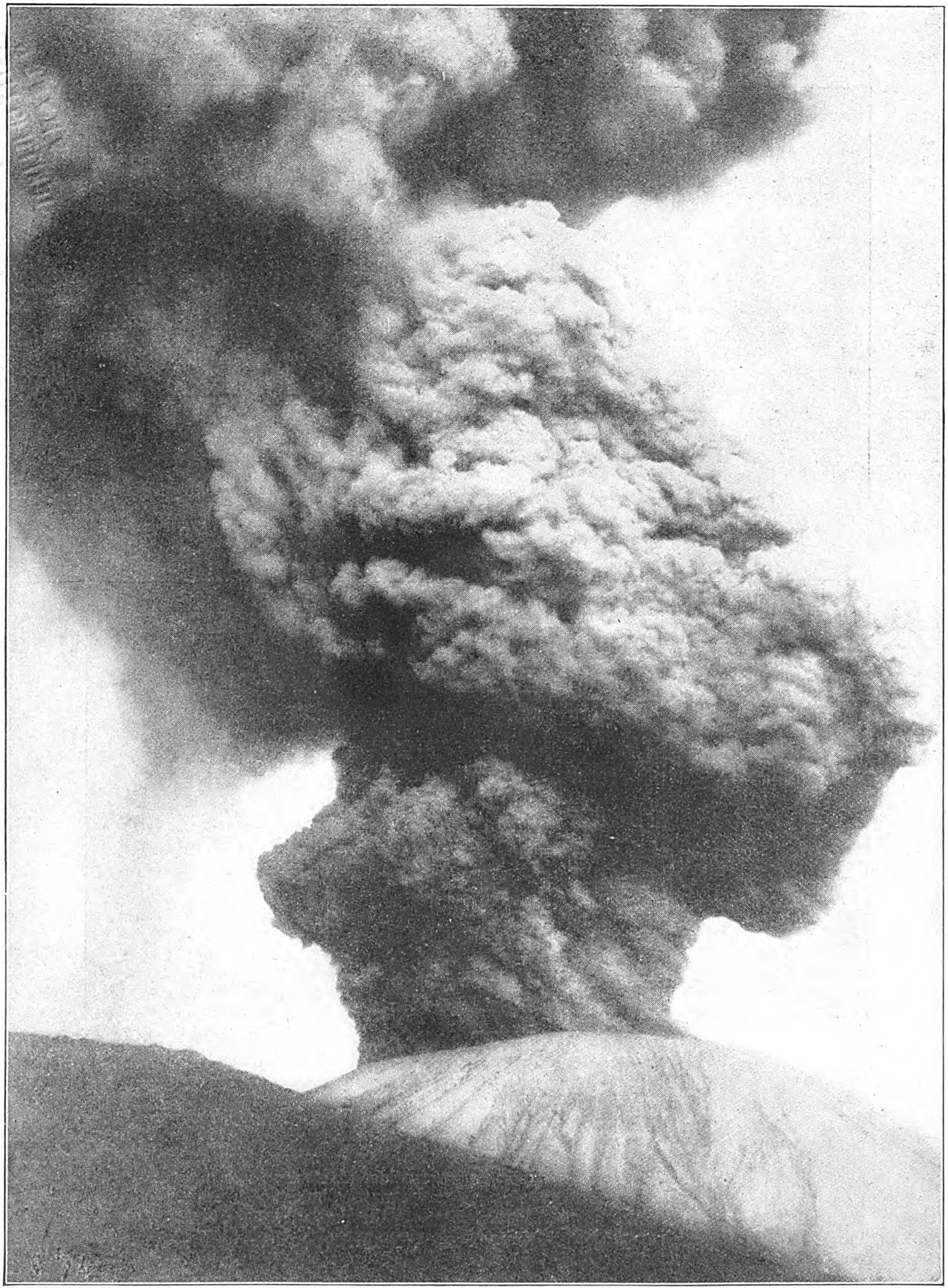

Photo by F. A. Perret

The Crater Cloud of Vesuvius

DURING the latter part of the eruption of April 14, 1906, great masses of material would fall from the sides of the crater and partially block the vent. This would often cause a great cloud of gas and ash—half a mile in diameter—to rise in majestic, spiral curves, and this condition would persist for hours until the vent could again clear for itself a vertical passage.

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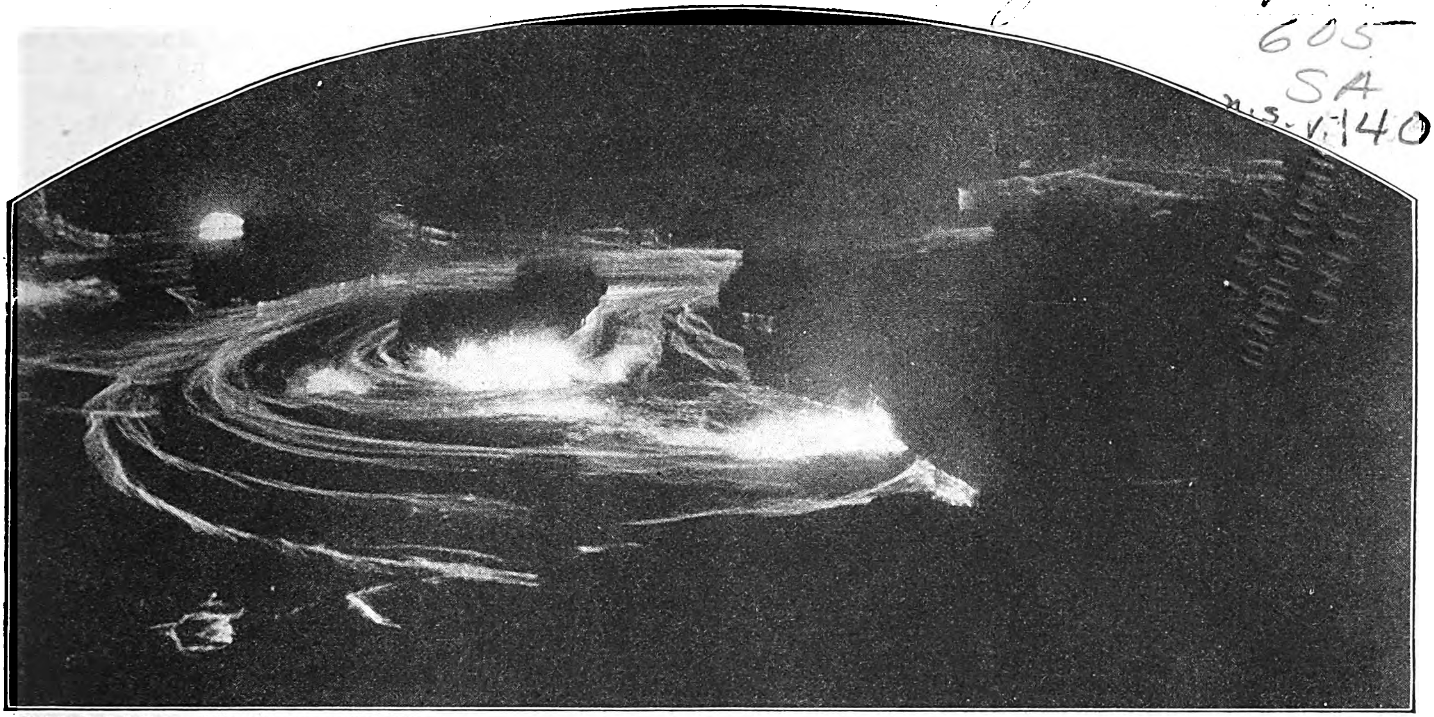

Photo by Dr. E. O. Hovey. All illustrations courtesy *Natural History*

A LAVA LAKE AT NIGHT

The Halemaumau pit in the crater of Kilauea, Hawaii, was filled for many years with a "lake of fire." The hardened lava in the center lasted for several months, forming a veritable island. This appeared as the top of a low truncated cone in the center of the lake

Belching Cauldrons of the Earth

Awe Inspiring to an Infinite Degree Are the Titanic Eruptions of Great Volcanoes

Engineering Library

By CHESTER A. REEDS, Ph.D.
Curator of Geology and Invertebrate Paleontology, American Museum of Natural History

THE eruption of a volcano is perhaps the most impressive and awe-inspiring phenomenon known. The stupendous releasing of matter and energy, the unhurried modulation of its periodic beats, the seismic pulsing of the ground, and the exceedingly rapid undulations of electric flashes in the cloud of ash, produce not only a sublime manifestation of rhythm, but of infinite dignity. Perret, in 1924, wrote: "No words can describe the majesty of its unfolding, the utter absence of anything resembling effort, and the all-sufficient power to perform the allotted task and do it majestically." The immensity of these forces, the magnitude of the results achieved, and the disastrous consequences which an eruption frequently entails, impress the human mind with the vast amount of dynamic energy pent up within the earth.

The 65 active volcanoes scattered over the surface of the earth are not in maximum eruption every day. Judging from their known histories, it is apparent that each volcano acts more or less independently of the others, and that the activity of most of them is intermittent with paroxysms of greater or lesser violence occurring after intervals of comparative, or even complete, repose. Stromboli, one of the Lipari Island volcanoes, has been characterized by a moderate, although somewhat constant, activity during 2000 years. To mariners it is known as the "lighthouse" of the Mediterranean. If the period of quiescence has been long, the renewed activity of a volcano is apt to be exceptionally violent. For example, Krakatoa, near Java, had been dormant for about two centuries before the great eruption of 1883.

ONE of the greatest of volcanic eruptions in recent years was that of Sakurajima in southern Japan. This volcano, with a cone shaped very much like Vesuvius, rises to a height of 3506 feet. Previous eruptions of this volcano had built up a circular island about seven miles in diameter in Kagoshima Bay, and upon it there were eighteen villages with an aggregate population of 22,000 farmers and fisher folk. Two miles of water lay between the western margin of the volcanic island and the shore of the larger Kyushu Island, on which stood the city of Kagoshima with a total population of seventy thousand persons.

The observatory of Kagoshima had recorded 91 earthquakes in 1913 as compared with only 34 for each of the years preceding. Early in January, 1914, this station noted an ever increasing number of earthquakes, and between 4 A.M. of January 11, and 10 A.M. of January 12, 417 quakes were recorded, many of them strong. The situation was ominous, and due to a knowledge of the significance of earthquakes in the vicinity of volcanoes, developed in Japan since 1890, the people in this region were forewarned, and those who dwelt on Sakurajima Island were removed prior to the violent eruption, which began at 10:05 A.M. of January 12, 1914.

The first outburst of gas, steam, and ash, which was from the western vent opposite the city of Kagoshima, reached elevations of between five and six miles in height. Ten minutes later a similar column rose from three crater pits on the eastern side of the mountain. Glowing bombs, hot sand, flashes of lightning, great billows of smoke, and seismic shocks waxed in fury. A terrific earthquake at 6:29 P.M. threw down walls and buildings in

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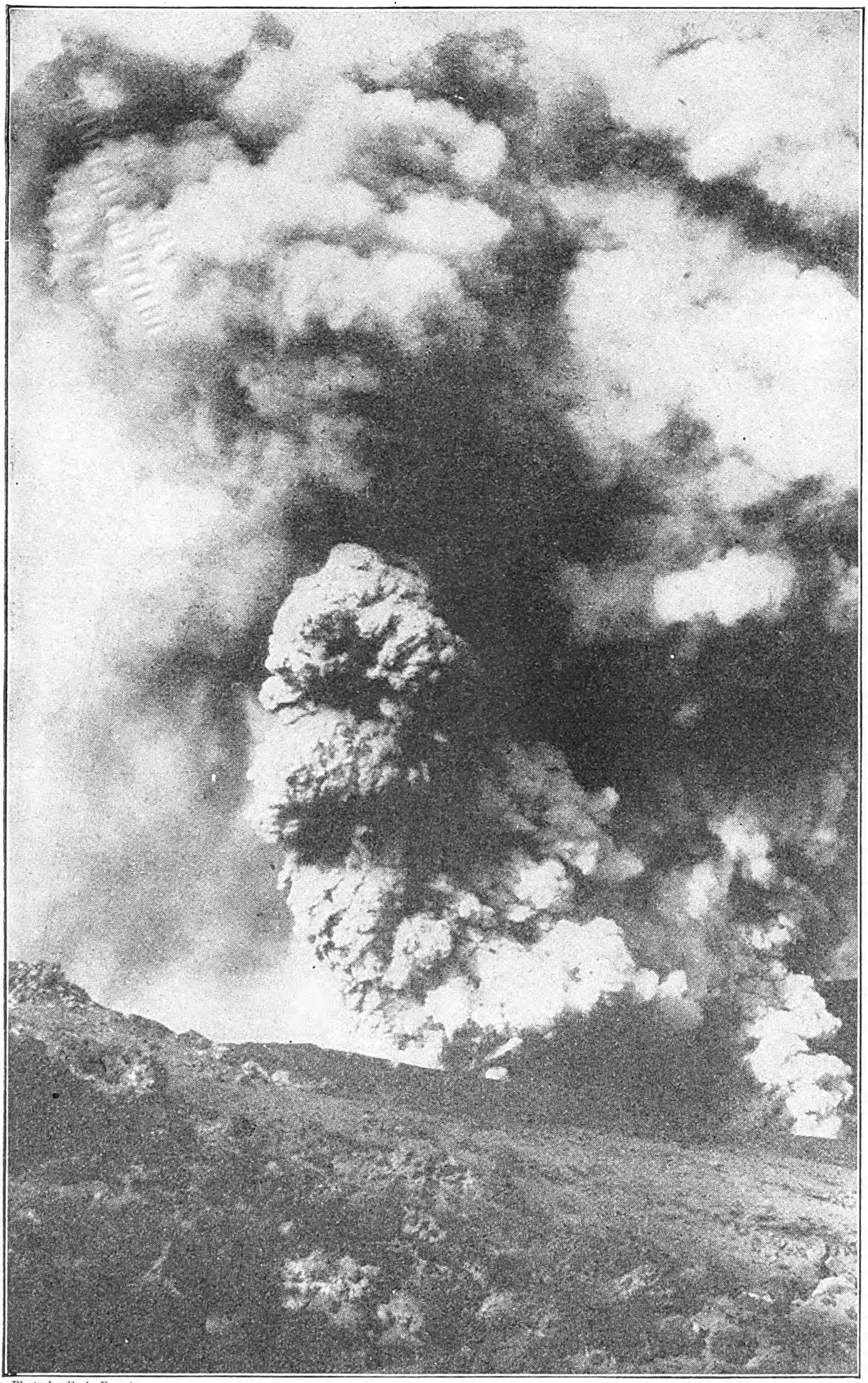


Photo by F. A. Perret

"CAULIFLOWER" ASH CLOUDS

In Japan the 1914 eruption of Sakurajima continued in action for many months, sending vast quantities of lava into the sea, and emitting huge ash clouds in continuous succession

respectively, on May 7 and 8, 1902, furnished a type of activity not previously recognized by volcanologists. These eruptions were characterized by the sudden emission of dense black clouds of superheated and suffocating gases heavily charged with incandescent dust, lapilli, and "bread-crust" bombs, which rose to heights of 12,000 feet and moved swiftly down the slopes of the volcanic cones like a hot avalanche, called *nuée ardente* by Lacroix.

According to Perret, the conditions requisite for the formation of a *nuée ardente* are believed to be a pasty lava, very highly charged with gas and so near the mouth of the crater that it might be expelled in the forms manifested at Mont Pelée and the Soufriére. Heilprin, Fenner, and Perret have noted that it is not improbable that a Peléean *nuée ardente* happened during the Plinian eruption of Vesuvius in 79 A.D., during the Katmai volcano eruption in Alaska in 1912, and during the 1914 eruption of Sakurajima in Japan.

The deadly effect of the Peléean blasts in Martinique and St. Vincent, which killed, within a few minutes, some 42,000 people, seems to have been due chiefly to the irritation of the mucous membrane of the respiratory passages by the fine hot dust. Those persons near the Soufriére, who took refuge in cellars, and the one prisoner in the dungeon at St. Pierre, escaped with their lives.

Vesuvius, in Italy, is the world's best known and most fully studied volcano. Of the period prior to the Christian era, little is known concerning the activity of this volcanic vent. The Greek geographer, Strabo (B.C. 63-A.D. 24), believed it to be a volcanic crater, though extinct. In his day the present complex cone with its *atrium* and partial *somma*, did not exist; instead there was only the complete outer ring, *somma*.

The terrific outburst of 79 A.D. was on such a grand scale that it constitutes one of the most outstanding events in the history of this volcano. This explosion was so tremendous that the greater portion of the cone, the *somma* ring, was blown to bits.

NO streams of lava issued forth, but such a vast quantity of lapilli and ash was thrown out that the city of Pompeii, to the southeast, was covered in places to a depth of 25 to 30 feet, and Herculaneum, to the southwest, was buried by a flood of mud and ash to a depth of 60 feet. These latter deposits have been covered by lava streams of more recent eruptions. From a study of the rocks in the Monte Somma remnant, Johnston-Lavis, 1891, determined a record of 14 periods of eruption and two long intervals of repose preceding the Christian era.

Between 79 and 1631, eight eruptions of Vesuvius are recorded, but little is known concerning them. Except for a slight outburst of ash in 1500, there was a long period of repose—1139 to 1631. During this interval the crater was forested and overgrown with vines, as it had been for a long time previous to 79 A.D. Following this long period of repose, a great explosive eruption occurred in December, 1631. This outburst began on December 15 with rumblings within the crater, following by an opening of a cleft upon the east side of the mountain, and the emission of steam and ash. On the following day, another fissure opened on the south side, from which steam and ash burst forth to overwhelm four nearby cities. On the 18th, four great streams of lava poured from the crater, three of them reaching the sea. Eight towns were overrun by these lavas and 3000 persons lost their lives. This eruption reduced the height of the cone by 560 feet.

Since 1631 five major eruptions have occurred, namely: 1737, 1794, 1822, 1872 and 1906; also nine minor emissions, to wit: 1834, 1839, 1850, 1855,

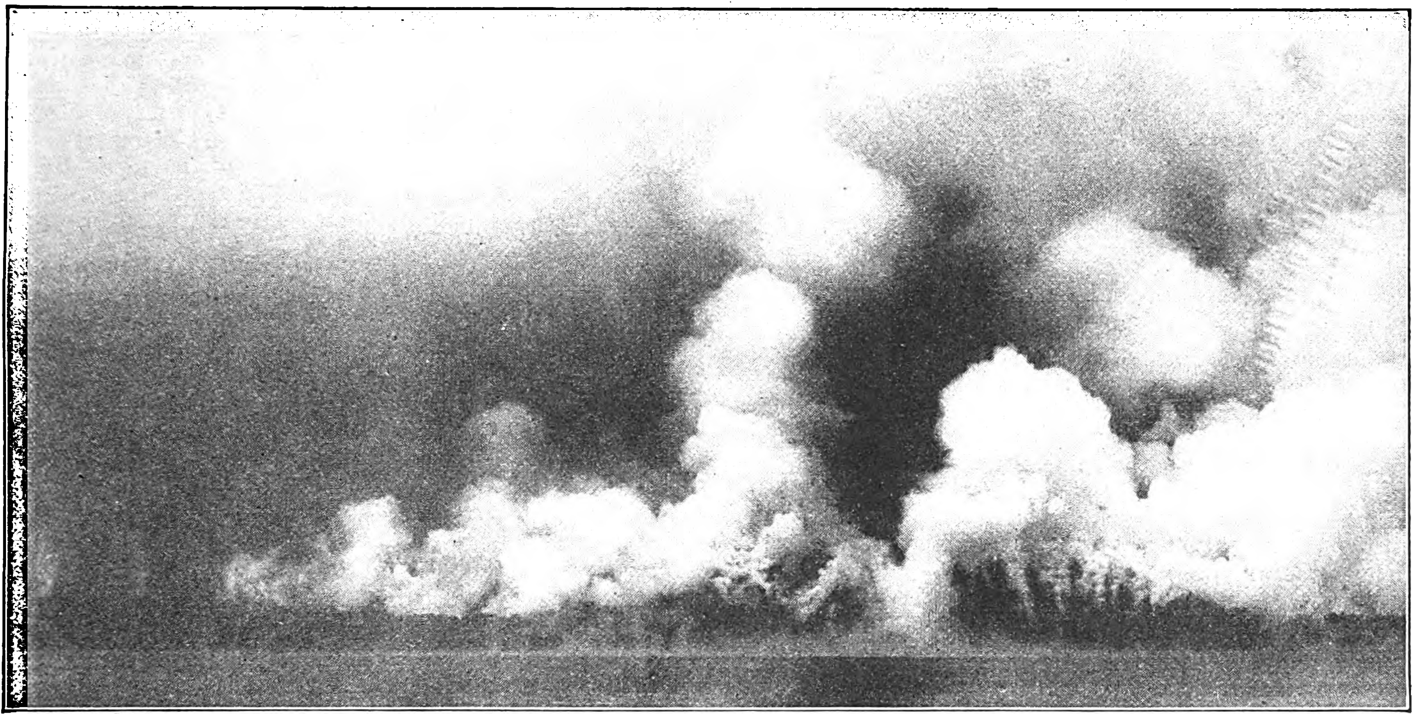


Photo by F. A. Perret

LAVA ENTERING THE SEA

This is the 1914 eruption of Sakurajima. When the material is sufficiently hot, a protective skin is formed on coming in contact with water or snow. In this view the lava is shown entering the water and flowing along the sea bottom without any disturbance at the surface.

1861, 1878, 1899, 1903, and 1913. During this period of almost 300 years a more nearly continuous form of activity has prevailed with explosive and effusive factors more nearly equal in proportion. The conduit of Vesuvius remained open throughout most of the time intervening between these later eruptions, thus causing a diminution and virtual elimination of the severe seismic disturbances which formerly, at the time of an eruption, affected the immediate region so disastrously.

The 1906 eruption of Vesuvius is of special interest not only because it passed through three phases of an eruptive cycle, but since it was carefully studied by the officials of the Vesuvian Observatory, one of whom, Dr. F. A. Perret, an American, has written a full account of those eventful days. Other volcanologists, chiefly French, German, English, and American, have also described this activity; hence it is one of the better known of the Vesuvian eruptions.

According to Perret there has been a marked periodicity in the modern eruptive process of Vesuvius, each great eruption releasing energy and material which have accumulated during a more or less prolonged period of lesser activity, in spite of occasional temporary relief through minor outbreaks. Then follows a period of repose, due to exhaustion and obstruction, after which the renewed supply of magma—rising slowly from the depths—re-establishes a vent at the bottom of the crater-basin, and a new active period ensues, completing a cycle.

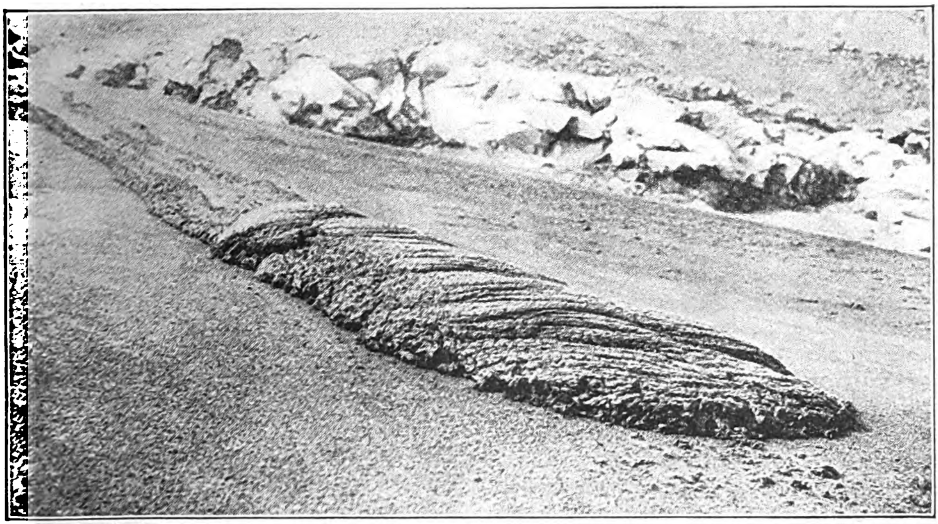


Photo by F. A. Perret

MUD LAVA FLOW

The fine ash combined with rain or condensed vapor makes a liquid mud which starts flowing down the mountain side and often becomes a much feared and destructive flood

Perret, writing in 1922, stated that the great 1906 basin of Vesuvius was then filled to within a short distance of the lowest portion of the rim, giving an accessible crater-bottom similar to that of Kilauea, but with a different kind of activity of far greater degree.

The nature of a volcanic eruption, whether "explosive" or "effusive," is assumed generally to be based upon the mere difference of fusibility of the rock emitted.

An important factor is whether the conduit has been normally open or closed during the period preceding the eruption. If closed, the magmatic reservoir will generate and accumulate gas in the liquid material within and beneath the volcanic edifice. When gas, the chief eruptive element, has accumulated in the uppermost magma in sufficient quantity to pierce the crater plug, the prompt release and ejection of all or a part of this matter will constitute eruption.

Perret considers the magma a paste, which permits the transfusion of gas and which changes into liquid lava in the upper part of the column. It rises slowly, and when it reaches the zone of fractured rocks, considered to be some six miles thick, it will be exposed to water and air. The assimilation of these modifying elements has a profound effect upon the physical and chemical activities and upon the prolonged existence and repeated functioning of the volcanic vent.

¶ *The foregoing description of volcanic eruptions is of particular interest at this time, due to the activity, as we go to press, of Mt. Etna in Sicily.*

Our Point

Unfinished Business

THE English press continues to be agitated by what it is pleased to call the desire of the United States to limit naval armament further—with reservations favorable to herself. Britain, generally, is of the opinion that we wish to challenge her superiority on the seas. She adopted a distrustful attitude toward our proposals at Geneva and, since the failure of that conference because she wanted 6000-ton cruisers with six-inch guns and we argued for 10,000-ton cruisers with eight-inch guns, has consistently shown her distrust of our motives by every means within her power.

Britain, and many people in our country, seem to have forgotten that, when at the time of the Washington Conference we had unquestioned potential superiority in battle cruisers and battle-ships, built and building, we indicated our intention of avoiding competition and the resultant enormous expenditures, and of showing to the world our peacefulness by *voluntarily* calling this conference. We would have gained superiority by simply continuing construction of ships already authorized or building and could have maintained it easily for a long time to come. Instead, we agreed to scrap, and did cut up with electric torches, powerful ships which had cost us many millions of dollars—and sold the scrap for nine dollars a ton! And yet we are accused of militarism!

Early in December when the Congress of the United States convenes (this editorial is being written in November), the second bill to be considered will be the revised Navy Building Program which was held over as unfinished business from the preceding session. This bill, if passed, will authorize the president to undertake, prior to July 1, 1931, construction of one aircraft carrier and 15 light cruisers, cost of the former not to exceed 19,000,000 dollars and of each of the latter not to exceed 17,000,000 dollars. As further evidence of our peaceful intentions, the bill carries the proviso that, "In the event of international agreement for (further) limitation of armaments, the president is authorized and empowered to suspend in whole or in part any of the construction authorized by this act."

Almost coincident with the convening of Congress, the final article of the naval series by Captain N. H. Goss, U. S. N., appears on page 38 of this issue. In letters to us from naval experts and others commending this five-part discussion of naval handicaps and present needs, Captain Goss has been praised as a strategist and student of naval affairs, and not without reason for he is of the younger yet seasoned, energetic, and forward-looking school of officers that is making tradition.

Captain Goss' presentation of the case for the navy is a masterful, correlated array of facts, not specious discursions; and is well worth thorough study by all those, at home and abroad, who are still of the opinion that the Navy Building Program is an aggressive gesture. The United States firmly believes not only that the ships on that program are necessary but also that more are needed, and that our navy should be rounded out into an efficient, perfectly co-ordinated protective machine. Furthermore, an agreement for further limitations should be made, in which case the president could suspend construction accordingly. Therefore, if the revised program passes, the navy will have accomplished only a part of what it hopes to do, and the bill may still be marked: "Unfinished Business."

The Disappearing War-Horse

DESPITE the mechanization of army equipment now taking place throughout the world, the horse has not outgrown his usefulness in war, and cavalry is still indispensable, according to Field Marshal Allenby of England. Himself the most distinguished leader of cavalry during the World War, his opinion has the weight of one who is thoroughly experienced in modern warfare and versed in its methods.

"The work of contact and linking up of units on wide battlefields will still fall to the cavalry," says Marshal Allenby. Airplanes will have their use in distant reconnaisance operations, tanks and armored cars in offensives, and motorized units for bringing up ammunition and supplies, but none of these will take the place of cavalry in certain operations. It is asserted that mechanized equipment will, as a matter of fact, increase the mobility of cavalry. That increased mobility would help prevent, in any future conflict, the deadlocked trench warfare that characterized the World War.

There will be many people—those who have been antagonistic toward our so-called mechanical age—who will be glad the horse has such an able defender. The animal has been a valuable asset to armies since the dawn of history, has held his own against countless new developments, and has always had about him a peculiar romantic glamour. In modern days, however, his race is dwindling and, although he may still be valuable in warfare, it is hardly to be doubted that he will, in time, give way entirely to the onward march of progress.

Not So Hard Boiled

IN this strenuous age ruled by a materialism that kills illusion, gives man no time for dreams, and keeps us on the treadmill, a little glimpse of the sun of romance awakens for a fleeting moment some almost forgotten, almost atrophied fire within us and we feel a warm glow suffusing that intangible part of us we call our souls. When a mighty governmental property bows down to the adventurous whim of a single, officially unimportant person, our appreciation of our fellow man undergoes a change; he can't be so bad, after all.

Recently the Gatun Locks of the Panama Canal were operated for the sole purpose of raising Richard Halliburton, romantic adventurer and travel writer, from the Atlantic Ocean level to that of Gatun Lake on his swim through the canal. The greatest war-ship afloat—the British battle-cruiser *Hood*, of nearly 45,000 tons displacement—used the same amount of water necessary to raise Halliburton; the same gates, weighing 1500 tons each, had to be operated; and Halliburton weighs only 160 pounds!

It is true that this incident took place during the rainy season and the millions of gallons of water used could easily be spared. But the officials responsible for the operation of the locks must have had a spark of adventure within them; they were human beings, not machines bound up with red tape. Officialdom can't be so hard boiled after all.

Diction in "Talkies"

BRITISH national pride in Britain's industrial prestige is cheered. Recent reports have it that, due to "superior diction," she expects to

# of View

lead the world in production of talking motion pictures. Statements to that effect, while not intended to be antagonistic, are to the United States both a challenge and a rapier thrust.

Touché!—exactly on a sore spot, too. Shamefacedly, we must admit that our diction is slovenly. Most Americans have forgotten—if they ever did know—that diction is that department of rhetoric which deals with the choice of words and modes of expression in literature, oratory, and song, and includes articulation, pronunciation, intonation, declamation, and punctuation. The language we use is generally atrocious and our manner of using it blood-curdling; we express our thoughts in the manner of school children and choose our words from the argot of the streets; mouthing our speech and breaking all the rules of rhetoric and grammar have come to be salient characteristics of the American people. And we defend our lazy English with a lofty wave of the hand and the remark: "Oh, but I'm too busy to be bothered."

Whether or not British diction is superior to ours is a matter of personal opinion. If talking motion pictures are measurably successful, however, assuredly there will be an interchange of such films between England and America. Hollywood is already busy improving its diction and therefore it is entirely possible that this consanguineous mating of "tongues" will conduce to the greater beauty and purity of the English language.

Requiem

QUIETLY, without panegyrics, and almost without notice, a famous invention that, something over two years ago, was tried, proven successful, and acclaimed throughout the world, has passed. Anton Flettner's rotor ship is no more. Substitution of Diesel engines for the rotors of the *Baden-Baden*, in a Staten Island ship yard, and a brief notice in a German newspaper announcing the dissolution of the company formed to exploit the rotor, marked its passing.

Hailed at the beginning of its existence as revolutionary and the precursor of a new era in shipping by water, the rotor ship made use of a principle of pure physics. When the rotor towers were revolved by a small power plant aboard ship, and a wind, however slight, struck them, the resultant air currents gave them a forward thrust out of all proportion to the force of the wind or the size of the power plant. And therein lies the hitch. Becalmed, the rotor ship was, like "a painted ship upon a painted ocean," unable to move. And yet the rotors had to be revolved continually in the hope of catching the slightest breeze. Therefore, much fuel might be wasted.

Had the rotor ship been developed before the day of steamships, its commercial success would have been tremendous. Depending upon uncertain winds, however, and still eating up fuel, it could not, in this modern age, compete with those fast carriers which follow time schedules from port to port.

The Practical Touch

RECENTLY we were asked to suggest a scientific play or program that might be presented at a special meeting of a class of boys in a technical high school. We suggested that eight or ten boys of the class each be assigned to read and study a different article in a current issue of some scientific magazine and at the meeting report on it from memory, each boy to be given three or four minutes to cover the more important aspects of his particular subject.

By many educators today, this sort of practical touch with current scientific thought is accepted as necessary but there are others who are like our old history teacher. She made of the study a most dry, uninteresting chore when, by proper presentation, she could have enthralled her pupils. What a chance she would have had to gain our love for the subject by telling, for example, when dealing with Napoleon, the dramatic and intensely interesting story of his son, L'Aiglon; or of many other interesting sidelights on other subjects.

Fundamental theories in science are necessary for the student but if the teacher stops with theories, the student will find, on graduation, that he is out of date. Those educators who recognize this should be commended, but those who do not are out of step with the times and should either get in step, or get out.

Vanishing Windmills

THOSE of us who have never had the privilege of visiting the country of Holland are prone to visualize it as a broad expanse of land dotted liberally with picturesque windmills. But science the prosaic, science the practical, seems ready to take this fond illusion from us. Recent reports from this land of wooden shoes and skates, not to mention dikes with holes for heroic youngsters to plug up with their fingers, seem to indicate that the windmills are doomed. Electric power is to replace them, merely because the windmills cannot turn out enough power. Already an international finance company has been formed for promoting the power projects, and so we might just as well change our idealistic mental picture of Holland to a more efficient one of humming electric machinery.

Sane Judgement Needed

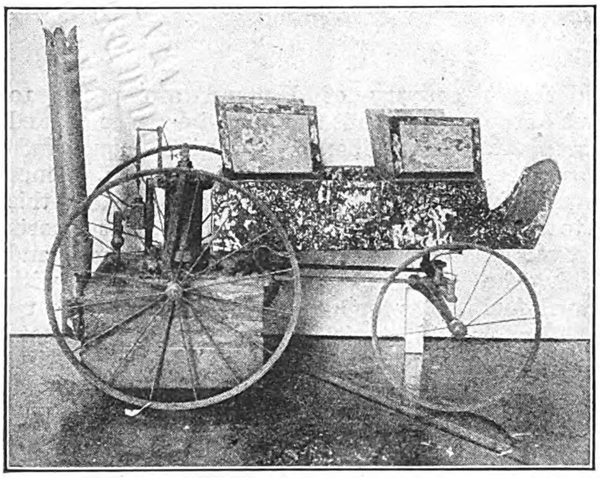
NOW and then someone, previously unknown, announces some discovery or invention that apparently transcends or ignores proven scientific laws. Newspapers play it up with mystifying sensationalism and the poor deluded public gulps and wonders until, finally, the claim is shown to be either fraudulent or groundless.

A few months ago, a motor that was supposed to obtain its power from the void was announced in this country. It was demonstrated, apparently did all that was claimed for it, was written up in great display in thousands of newspapers, and then dropped from sight.

A few weeks ago, papers announced the discovery, by an Englishman, of a metal that counteracted gravitation—that will float in the air. It was claimed that if this metal were used in airplanes, it would hold them up as gas holds up a balloon. Scientists guffawed and demonstrated the phenomenon—with simple magnets! The principle involved is one that may be found in any elementary physics text-book: "Like poles"—of magnets—"repel; unlike poles attract each other."

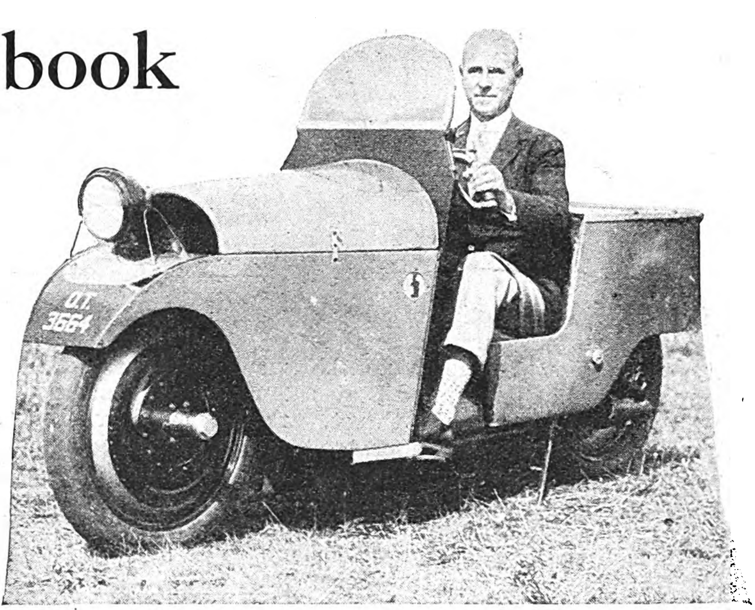
There may have been some excuse for the first claim; for the last there was absolutely none. Personally, we believe the Englishman was having his little joke, was "pulling the legs" of the newspaper men. Unfortunately, the onus fell upon the newspaper readers. Consequently, we would advise a little less credulity when such startling claims are made, at least until they are substantiated by the reports of accredited scientists.

From the Scrap-book of Science



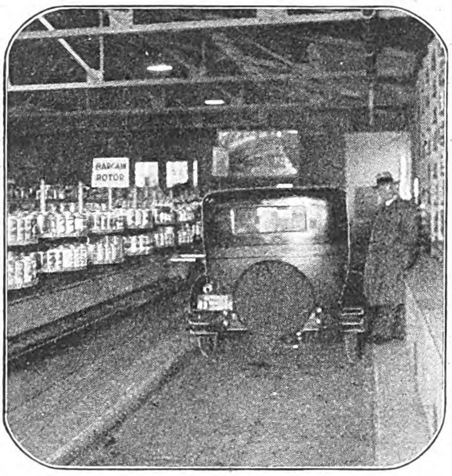
IS IT THE WORLD'S FIRST?

Said to have been conceived long before the era of the automobile, this steam-driven buggy, still in working order, was recently discovered among other relics at the University of Maryland. It was invented by the late Dr. W. E. A. Aiken, Professor of Chemistry and Pharmacy, 1838-1888



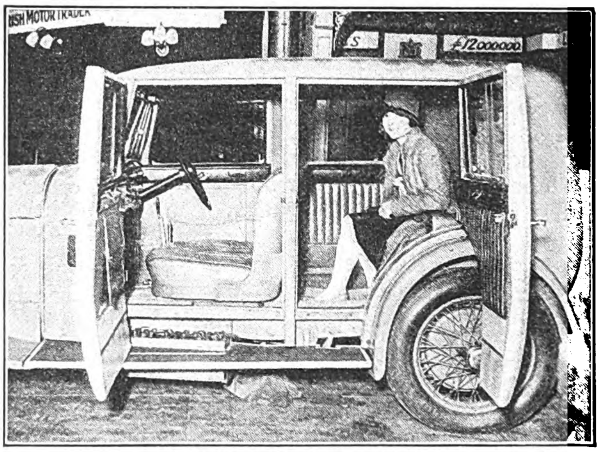
AS COMFORTABLE AS AN AUTOMOBILE

A famous English airplane designer and pilot, A. V. Roe, has built this unique motorcycle which bears a striking resemblance to a small automobile. Its steering gear is similar to that of a car; the seat is upholstered; and it is equipped with a windshield. It is said to be capable of a speed of 60 miles an hour. (See front cover painting)



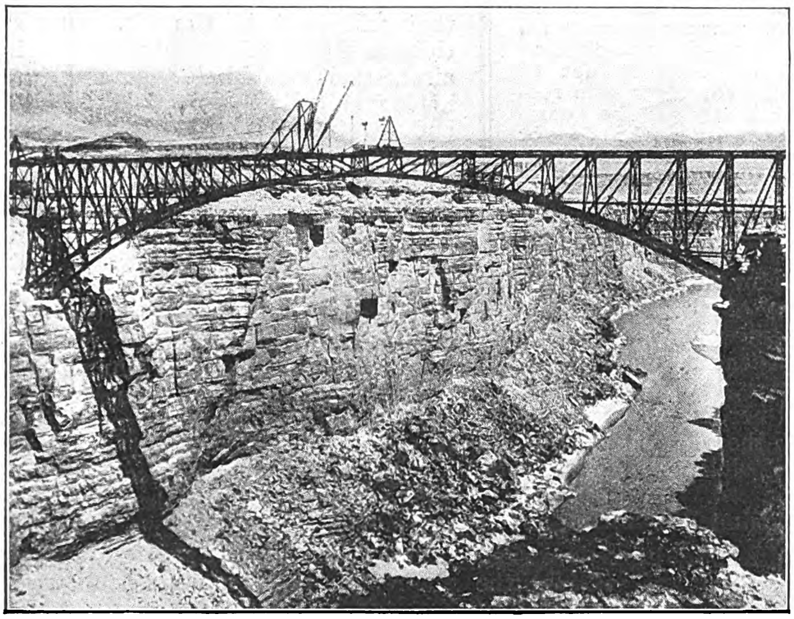
◄ **AUTOMARKET** ▲

Something new in the way of a "serve yourself" store. The cars of customers pass down one lane while pedestrians use another, each taking what they wish from rotating stands. Goods are placed in carriers and checked for all customers in the usual way



A WIDE OPEN SEDAN

This car with doors of extraordinary width attracted much attention and caused favorable comment at the recent Olympic Motor Car Show in London. As may be seen, both the front and rear doors open wide enough to provide easy access to the interior for the driver and passengers and luggage

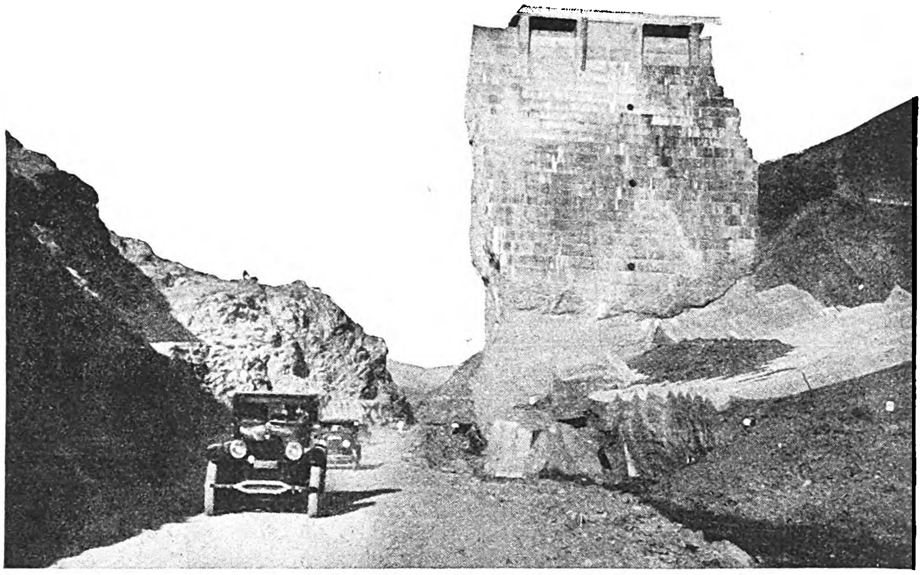


◄ **GRAND CANYON'S NEW SPAN**

Bridge over Marble Gorge of the Grand Canyon of the Colorado, which will soon be open to traffic. It will be named and formally dedicated June 1, 1929. The 616-foot span was built out from each end and the two sections were joined with a huge pin. The concrete floor is now being laid and the approaches are being built by the Arizona Highway Department

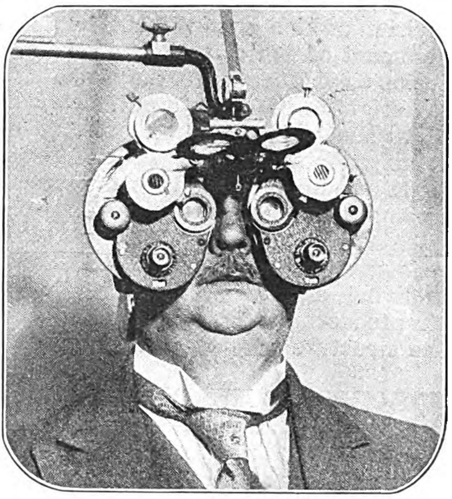
"MOSQUITO" FIREBOAT

One of the small, easily maneuvered fireboats of the Boston Fire Department. It is driven by a powerful outboard motor and is able to dart in and around docks where larger boats cannot go. The pump shown in the center draws salt water from the harbor and sends it through the hose



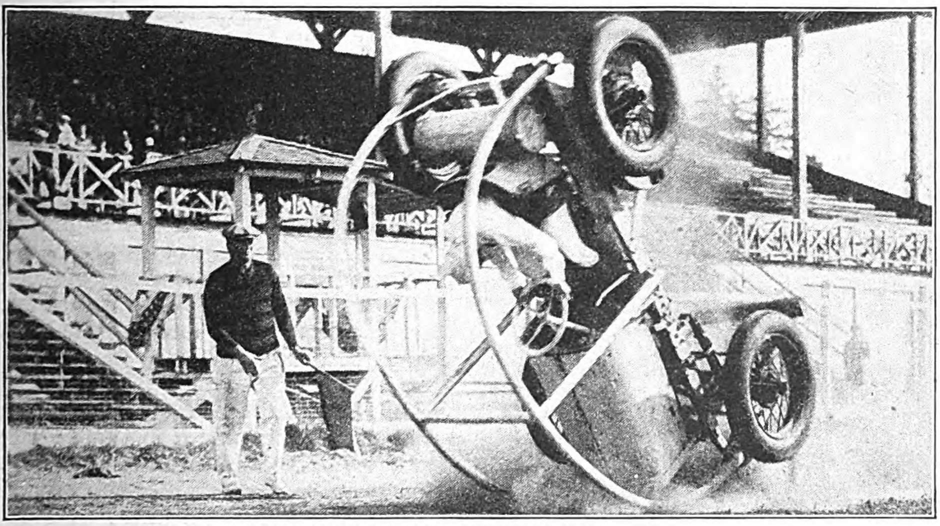
WHERE HUNDREDS DIED

Thousands of autoists now travel a scenic road through the valley, near Los Angeles, where the waters from the collapsed St. Francis Dam took a huge toll of lives early in 1928 (see SCIENTIFIC AMERICAN, June, 1928). The huge central portion of the dam still stands like a grim monument



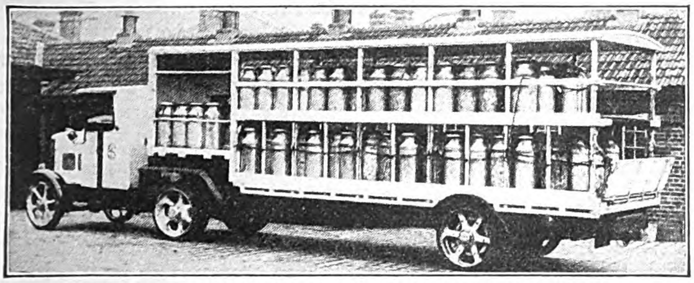
A MILLION LENSES

Although this new instrument installed in the London Refraction Hospital does not actually consist of that number of lenses, the effect is the same for, with it, the optician can secure one million combinations of lenses instantaneously. It is said to be capable of determining the slightest defect in the patient's eyesight



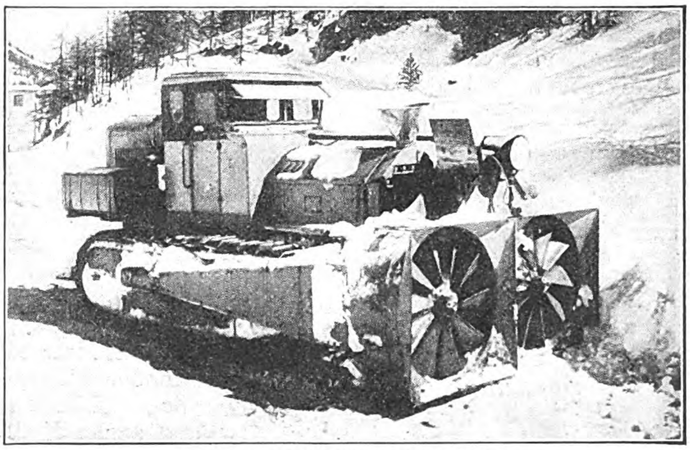
GRAND-STANDING WITH A TRICK CAR

A 19-year-old girl driver, Miss Estis, photographed in action at Centralia, Washington, as her trick car rolls over on its rockers. The speed of the car at the time of the somersault is said to have been 30 miles an hour. After turning over, the car continued on its way with no more than a severe jolting for the daring driver. It was necessary, of course, that Miss Estis be strapped into the seat



DOUBLE-DECKED MILK DELIVERY TRAILER

To facilitate delivery of milk and allow the carrying of larger loads than heretofore, this new double-decked lorry has been adopted in London. It is equipped with six wheels and the carrying part of the body is similar to the freight trailers commonly used in America at present



SNOW-EATING SNOW PLOW

Literally eating the snow from the roadway that is being cleared, this novel snow plow is used on mountain roads and in the streets of Swiss resorts. The plow, on a track-laying tractor, pushes through soft snow which is drawn in by the turbines and ejected through openings in the boxes at each side. The advantage of this method of snow removal lies in the fact that the snow is not packed

What *Is* Life?

Fascinating Pseudo-cells Which Display the Non-Living Features of Protoplasm May be Made by the Amateur With a Few Chemicals

By EMMA REH STEVENSON

CHOOSING for his field of research for 30 years the borderland between the inorganic and organic world of matter on the fringe of recognized science, Professor Alfonso L. Herrera, chief of the division of biology of the Mexican Department of Agriculture, has obtained curious evidence that may relate to the origin of life upon earth.

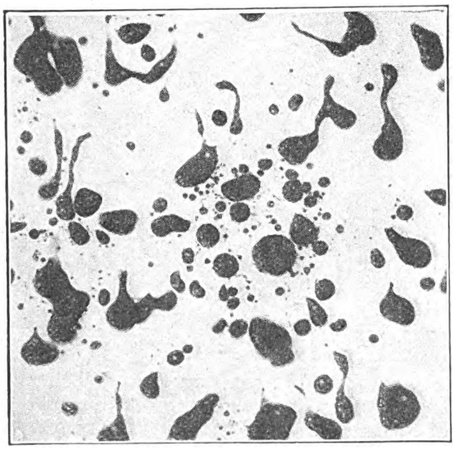
He has taken both mineral and organic substances and created from them pseudo-cells and pseudo-protoplasms that mimic life itself. His microscope has revealed imitation cells that resemble very closely those of living organisms, amoebæ, spores, streptococcus chains, bacteria, and the structure of protoplasm.

PROFESSOR HERRERA makes no extravagant claims. He merely shows that the mysterious activities of life cells and the special forms and shapes of living substance can be imitated by common mineral and organic materials that do not possess the so-called life force. He therefore believes that life is not a special phenomenon, but a property which all matter possesses under the right conditions.

Perhaps the most interesting of all of his "artificial beings," as Professor Herrera calls his imitation cells, are his "colpoids" which resemble both in appearance and in behavior the creatures called amoebæ by scientists.

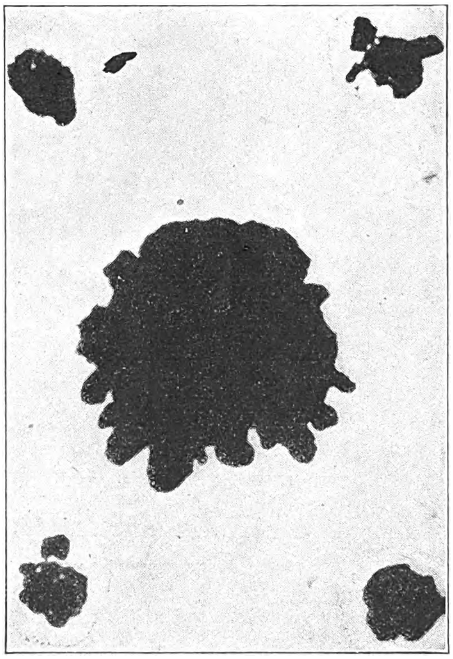
He treats the visitor to his laboratory to a sight of the antics of his favorite laboratory "children." He dissolves 50 parts of olive oil in 100 parts of gasoline, and 14 parts of soda lye in 100 parts of distilled water, adding a pinch of aniline black to this latter solution so that the observer can distinguish the two.

The oil-and-gasoline solution he puts into a porcelain dish with a flat bottom which he levels mechanically so that any movements in the liquid will not be due to gravity. With an eye dropper he takes a small amount of the black soda solution and inserts it under the surface of the gasoline-oil mixture. Then he hands the visitor the magnifying glass.



THE SECOND STAGE

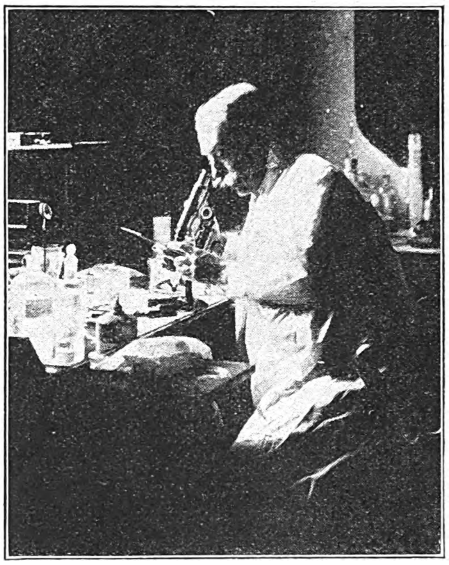
One large drop breaks into rapidly moving parts which shake and tremble



THE EXPERIMENT

The several ingredients are mixed, and a drop of the soda solution "comes to life"

Almost immediately things begin to happen. The black drop becomes alive and begins to sway and tremble and shake itself. It begins to pant and breathe and divide itself into parts. These parts begin to skip around rapidly in a dissatisfied manner, pursuing, evading, and battling with other droplets for their bodies. They extend armlike appendages and fight vampire fights.



PROFESSOR A. L. HERRERA

In his laboratory at the Mexican Department of Agriculture where he experiments

They act for all the world like real single-celled living creatures going through the ordinary routine of life. They "eat" and "reproduce" like the amoeba swimming in a pond looking for its daily bread and peopling it with other amoebæ.

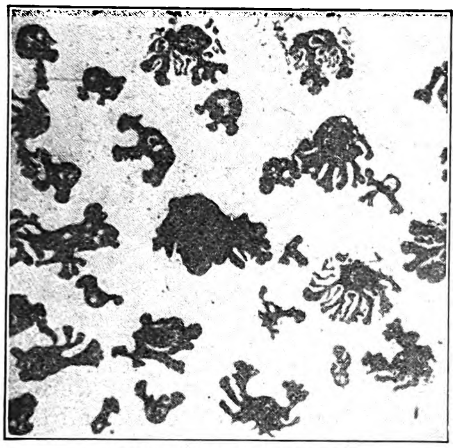
Professor Herrera does not claim that his oil-and-soda creatures are alive, for he can explain their strange life-like antics and amoeba-like shapes by well-known chemical and physical theories. The oil-and-soda solutions react according to the chemical process of saponification, a process the housewife used to take advantage of when she made her own soap, using rendered animal fats and leached lye from wood ashes.

WHEN a drop of the black soda solution is placed in the oil mixture, saponification immediately begins to take place around the outside of the drop, forming a thin membrane of soap around it. Then there is a black solution of one nature wrapped in a delicate bag and suspended within another solution of an entirely different disposition and character.

The soap bag which encloses the soda drop, like the membranes that envelop animal and vegetable cells in real life, is semi-permeable, and permits certain molecules to pass through. A social war of equalization takes place in an effort to make conditions on the inside of the drop more like those on the outside.

The equalization struggle is the process of saponification. Under the microscope this ordinary struggle of one solution on the outside looking in with the other one on the inside looking out, is fascinating to watch.

Tiny currents of excited material seem to be streaming through the pores of the membrane, and an active interchange of material is seen to be taking



THE THIRD STAGE

The parts begin to assume a pseudo-resemblance to amoebæ. Still active

place. Movements are set up within the black drop which change its shape every moment. As the battle between the two sides progresses, the composition of the black drop is changing and saponification is increasing.

The speed with which the soda cell runs through its allotted time depends on the temperature of the reacting solutions. At about 50 degrees, Fahrenheit, the mortal struggle lasts about 45 minutes and then the imitation cell lies spent and quiet, and has changed from an exciting "creature" to a little bit of soap.

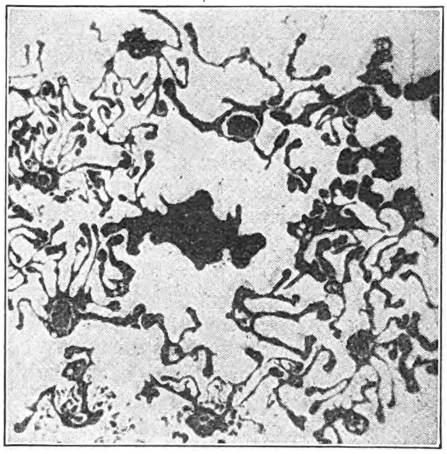
OTHER forces besides those of osmotic pressure come into play in the lives of his colpoids, Professor Herrera explains, and these are the physical forces of surface tension and the electrical charges on the surface of the drops which have so much to do with their likes and dislikes of each other. Surface tension forces the drop to take the spherical form as the most economical shape, but the currents caused by the chemical interchange of material are forever modifying its figure.

In order to study these various forces further, which Professor Herrera believes are analogous to those taking place in living cells, he suggests a curious experiment for some future scientist to perform who is interested in this neglected field for research. He suggests an artificial lake of gasoline and oil in which a large amount of black soda solution might be suspended. The physical forces and electrical properties of the reacting bodies could then be better measured because of their enormity, he believes.

Professor Herrera's colpoid or artificial cell of soda and oil is perhaps his most spectacular artificial "creature," but he has mimicked many other structures by means of other chemical substances. His first experiments were with organic substances such as tannin, oleic acid, albumin, and fats, but he discovered that his best results were obtained when certain mineral impurities, such as soluble silicates, were present. In course of time he succeeded in obtaining on his microscope slide structures resembling isolated cells, spores, streptococcus chains, bacteria, and protoplasms.

One of his simplest methods of preparing a pseudo-protoplasm in his laboratory today is by sprinkling a bit of Merck's chemically prepared powdered egg albumin upon a drop of nitric acid on a microscope slide. Remarkably realistic structures arise which appear almost identical with the structure of living protoplasm. By varying the acid, Professor Herrera can vary the type of protoplasmic structure.

"These various experiments are not without biological significance," Professor Herrera states. "The reproduction of such structures and their identity with the morphology of living protoplasm and living cells indicates that the physical basis underlying the two must have much in common. And I believe the parallelism exists from the chemical point of view as well.



MORE ACTIVITY

The "amoebæ" have extended their "pseudopods" still farther. They still move

"Of the two theories of the origin of life, the one which holds that it has its beginnings in inorganic rather than organic substances is easier, for organic substances are hardly conceivable in a primitive world.

"I do not pretend to have proved through my experiments that such has been the origin of living things on earth, but I do believe that I have at least obtained evidence in that direction.

"The combinations of solutions produced by the reaction of water and the earth's atmosphere with the constituents of the soil, are able to produce all the cellular structures which I have produced in my laboratory," Professor Herrera says.

He sees an inescapable parallel, with inescapable conclusions, between the artificial creatures of his laboratory and structures in real life. The amoeba moves about in its pool of water by the streaming of its body substances, and it extends arm-like appendages which scientists call pseudopods, in order to get its food.

In the arm-like extensions of the black soda drop which it uses to get a vampire grip on its rivals, Professor Herrera sees the counterparts of the pseudopods of the living amoeba in the brook. And in the pseudopods of the amoeba he sees the foreshadowing of arms and legs in the various higher forms of life.

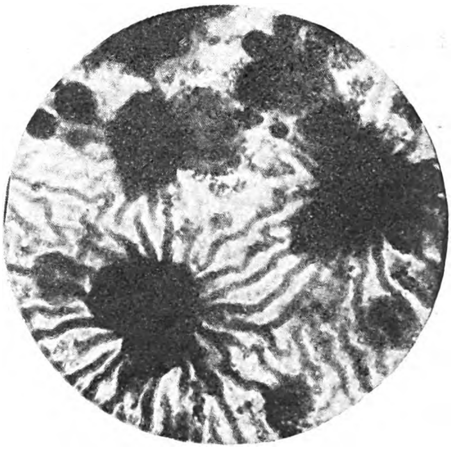
The simple amoeba glides about in its sunny pool, taking up what things it likes for food as they come within its reach. If they are few and far between, its excursions become wider and faster.

The tiny water-hydra, simplest multi-celled thing, awaits with its appendages the arrival of its prey. When none arrives it merely changes its shape and its position and lies in wait once more.

THE caterpillar born on the trunk of a tree crawls to the branches to reach the leaves on which it feeds. As the scale of life is ascended and the behavior of the organism becomes more and more complicated, the various physical and chemical reactions become so confused with what are called instincts, at the bottom of which they must lie, that they are completely lost sight of.

The struggles of a man to get food by robbing a bank or getting a job in another factory are as much the result of internal chemical reaction as the behavior of the caterpillar on the tree, the hydra in the brook, the amoeba in the sunny pool, or the excited black drop skipping about under his microscope, Professor Herrera believes.

Professor Herrera's conclusions are the result of 30 years' work in which time he has made nearly 6000 experiments in this field of hitherto uncredited research, and which is beginning to attract the attention of many authorities in various parts of the scientific world.



PSEUDO-CELL DIVISION

This resembles an illustration of amoebæ division found in Smallwood's Biology

Where To Put It?

Few Realize How Many Factors Will Have to be Considered in Selecting Scientifically the Best Site for the New 200-Inch Telescope

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

AS these words are written the main topic of astronomical interest is, beyong question, the great telescope which is to be constructed for the California Institute of Technology. So much has been written about it, and so much more will doubtless appear before these lines see the light, that the main outlines planned will already be familiar to our readers.

Nor is there any reason to explain why an increase of telescopic power will be of value to science, nor to fill a page with a detailed statement of what the 200-inch reflector may do when it is in operation. The problems which arise at once and must be solved by the astronomers who are responsible for the new observatory are of equal interest and more pressing in importance. With so much at stake every detail must be most carefully weighed.

For example, it is already announced that experiments are in progress looking toward the construction of a disk of fused quartz for the great mirror. Since the coefficient of expansion of this material is about six percent of that of glass, the perennial difficulties which arise from the distortion of the glass mirror by unequal changes in its temperature should be greatly diminished. A quartz mirror would, therefore, be far superior to any other, but the task of melting and casting tons of this highly refractory substance into a flawless disk will tax the highest engineering skill. Other important problems of engineering, although more familiar, will include the construction of the mounting, the great piers, the skeleton tube, and the devices for moving it both uniformly to follow the stars and at will for setting.

A NUMBER of economic factors complicate the matter. Should the new telescope be in its general proportions a larger replica of the 100-inch, it would be twice as long and require a dome approximately twice as big. To build this is practicable but would be exceedingly expensive. If, however, the mirror is designed with sharper curvatures, so that the focal length is smaller in proportion to its diameter, the cost of dome and mounting will be reduced.

But here, of course, there are still more important factors to be considered. With the shortened focus the brightness of the erect image of a nebula (for example) will be increased and this is an obvious advantage. But everything has its drawbacks and in this case the field of sharp definition is smaller. A parabolic mirror, if accurately figured, gives an admirable image of a star on its axis of symmetry, but for stars whose light falls on the mirror at other angles the images are less perfect.

A star half a degree from the center of the field gives a fan-shaped image which cannot be brought into sharp focus by any adjustment. The fault is not with the instrument, nor does it come from the wave-properties of light. It is a direct consequence of the geometry of reflection from a curved mirror, and it is easy to show that no possible form of surface could improve matters for stars at the edge of the field without spoiling the image at the center.

THE shorter the focal length compared with the aperture of the mirror the worse will this difficulty be, and the smaller the field of passably good definition. Here, then, a compromise is in order, and a decision to make the focal length about three and one half times the diameter has been reached, after careful consideration of all the financial and optical factors which are involved.

Still more important is the problem of the observatory site, and here again technical, economic, and human considerations all come into play. The first requisite is obviously that the climatic conditions shall be the best available. The necessity of the maximum number of cloudless nights during the year would be recognized by the uninformed, and a very little astronomical knowledge enables one to add the requirements that the air shall be both transparent and steady.

We who live at sea level, especially if we dwell near cities, hardly realize how clear the sky can be. We are so used to a more or less hazy or dusty atmosphere that we think it is natural to see long "rays" of light where the sunbeams come through breaks in the clouds. But in really clear air these beams almost disappear. A simple test, and yet one of the best, is to hide the sun behind the edge of the building, or even the hand, and note how much the sky brightens near it. Under ordinary conditions in the east a conspicuously bright whitish cast will be seen extending several degrees from the sun and brightening still more close to it.

But under really clear skies all this is absent and the heavenly blue extends right to the sun's edge—a little brighter indeed but not perceptibly altered in color. Such clear skies are very rare here, although they may occasionally be seen. To find them often we must seek regions where the air is not befouled with smoke or thickened with haze. Sometimes they appear at sea level (as the writer noticed off the coast of Norway last summer) but they are found in perfection at high altitudes. On a mountain top, or for that matter in an airplane, one gets above the lower and denser layers of air which carry almost all the dirt, and the sky is darker as well as bluer.

There is a limit to the gain which can be made in this way, for the molecules of the air themselves scatter light and a certain degree of sky brightness is therefore unavoidable. The measures of Abbot on Mount Wilson show that this theoretical limit is very nearly reached there under good conditions, and there is every reason to believe that at many other stations the air is also often as clear as air can be.

IF we could find a mountain 20 miles high, make a way to its summit and contrive to live there after we reached it, we might do better. In practice, however, the gain by going up more than 10,000 feet or so is offset by other conditions.

Steadiness of the air is even more important than transparency, especially for a great telescope. The larger the instrument the broader is the column of air extending to the top of our atmosphere through which the light of a star passes, and the greater is the chance of picking up trouble. If anywhere in this column there are masses or streaks of air of unequal density these will deviate the light by their refraction. The rays which arrive at the telescope will not all be parallel; and no mirror, however perfect, can bring them to a sharp focus. The image will be distorted and fuzzy, and moreover will dance and "boil" as the wind sweeps new air bodies in the path of the rays. When the air is full of larger rays of this sort, such as those which produce the aviator's "bumps" or "air pockets," the images become so bad that it is little use to attempt observation.

It is of vital importance, therefore, that the new telescope should be situated in a region of settled weather, out of the normal tracks at least of the great cyclonic storms which sweep over the northern and central parts of Europe and the United States. The southwestern part of the country is best situated in this respect.

But local as well as general conditions enter into this matter of "seeing." A sharp mountain peak is almost sure to be bad, for ascending currents of air rise from the slopes below by day. A narrow valley catches cold descending currents by night. The most favorable chances are to be expected on a high plateau on the top of a broad-backed mountain. For similar reasons a forested mountain is preferable to a bare one, and fields of bare rock which are strongly heated by the sun are to be avoided.

Principles like these narrow down the choice a good deal. But as in all matters of weather, exact predictions cannot be returned. The only way to settle the question as between the more promising sites is to have actual observations made by a skilled observer, and with a telescope of moderate size or with the interferometer. Since the *average* conditions throughout the year are decisive, such observations must be made on many nights in all seasons. To make adequate tests of this sort at many places will be one of the most important and the most time consuming things that lie before the investigators.

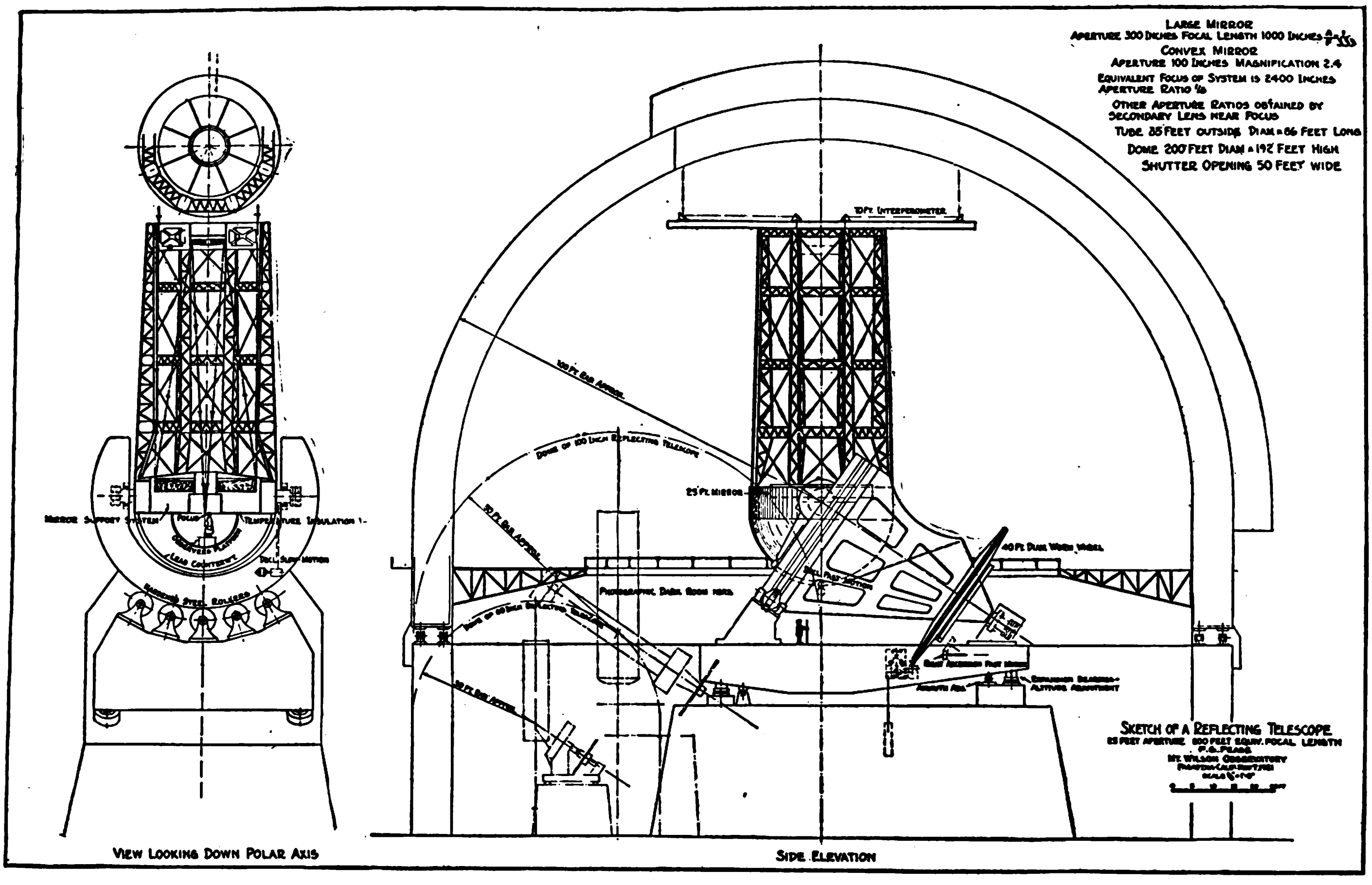
But the problem is not solved merely by finding good observing conditions. These, in the mathematician's language, are "necessary but not sufficient." The site must be accessible. One remembers the story of the mining engineer sent to investigate a claim which the discoverer offered for sale suspiciously cheap, who telegraphed back east "Ore there. Up to sample. Lots of it. Will need pack train of bald eagles to get it out." The road up Mount Wilson cost a hundred thousand dollars, and a site which is too costly must be dropped from consideration.

THE observatory must be located, also, in a habitable place. Although the astronomers will doubtless come for observing "spells" of a few days, returning to work up their photographs while others take their places at the telescope, a staff of mechanical and other assistants will establish their permanent homes close to the great dome.

Finally, there is an economic problem of a different sort—not of money but of time. The relation of the new observatory of the California Institute makes it certain that the central offices—the Astrophysical Institute at which the observations will be reduced and the theoretical work done—will be on its campus in Pasadena. The experience of the Mount Wilson staff shows that no inconvenience is caused by having the observatory two hours run away over a hard mountain road. Indeed, when the first telescopes were erected there the trip was made on horseback or on foot and took much longer. With present means of transportation a distance of a hundred miles need not be a serious obstacle, but a whole day's journey by rail would be a different matter.

It has been tentatively decided, therefore, to place the great telescope within a night's ride or thereabouts from Pasadena. This still leaves a very large extent of country open for investigation, including the best climatic zone (astronomically speaking) in the United States, and a great variety of topography. It will be a good while yet before the question can be settled.

This is by no means an exhaustive survey of the factors which must be considered. But enough has been said, perhaps, to show that if the plans for the new observatory seem to be hanging fire, this will be far from indicating that nothing is being done. A great deal of hard labor must be put in, even before the land is bought and the ground broken.


LARGE MIRROR
APERTURE 300 INCHES FOCAL LENGTH 1000 INCHES
CONVEX MIRROR
APERTURE 100 INCHES MAGNIFICATION 2.4
EQUIVALENT FOCUS OF SYSTEM IS 2400 INCHES
APERTURE RATIO
OTHER APERTURE RATIOS OBTAINED BY SECONDARY LENS NEAR FOCUS
TUBE 35 FEET OUTSIDE DIAM – 86 FEET LONG
DOME 200 FEET DIAM – 192 FEET HIGH
SHUTTER OPENING 50 FEET WIDE
70 FT. INTERFEROMETER
100 FT. BAR APPROX.
DOME OF 100 INCH REFLECTING TELESCOPE
25 FT. MIRROR
30 FT. BAR APPROX.
PHOTOGRAPHIC DARK ROOM HERE
DOME OF 60 INCH REFLECTING TELESCOPE
40 FT. DIAM. WORM WHEEL
DECL. FAST MOTION
AZIMUTH ADJ.
MIRROR SUPPORT SYSTEM
FOCUS
TEMPERATURE INSULATION
OBSERVERS PLATFORM
LEAD COUNTERWT.
DECL. SLOW MOTION
HARDENED STEEL ROLLERS
SKETCH OF A REFLECTING TELESCOPE
25 FEET APERTURE 200 FEET EQUIV. FOCAL LENGTH
F. G. PEASE
MT. WILSON OBSERVATORY
VIEW LOOKING DOWN POLAR AXIS
SIDE ELEVATION

BASIC DESIGN FOR THE 300-INCH TELESCOPE, AS PROJECTED TWO YEARS AGO

The same type of mounting will be used for the 200-inch telescope. This split-ring equatorial type, turning in right ascension on rollers, was first described by Russell W. Porter, in *Popular Astronomy*, 1918. In the Porter "garden" telescopes it proved successful

Railroads Turn To the Highways

To Protect Revenues and Give Better Service, Steam Railroads Adopt Motor Buses

By F. D. McHUGH

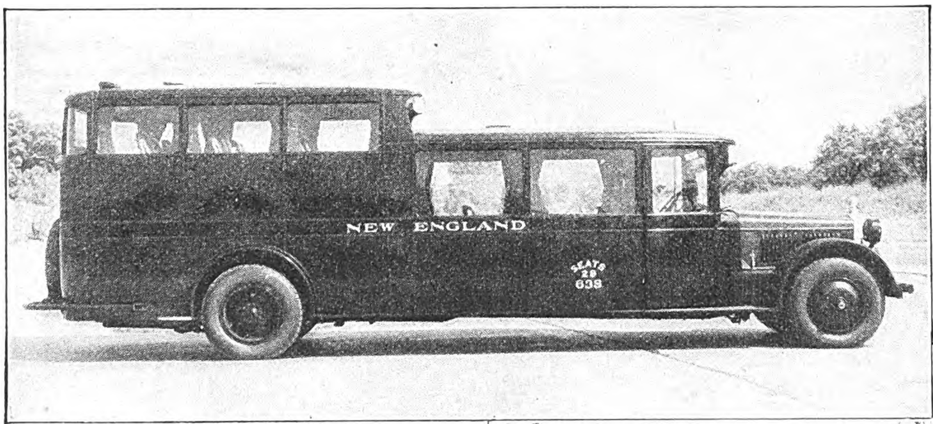
Courtesy The Reading Company

A MONSTER OF THE ROAD

The Reading Company has a well-organized, supplemental highway system

MOTOR coaches—or motor buses, as they are more commonly designated — have been used for interurban or cross-country service only a few years, but now they travel on regular routes that form a fine network covering the entire country. In the early days of bus travel, the service was mainly local, the transportation companies then in operation being usually of a "wild-cat" type, and more or less irresponsible. The lines ran for short distances between small country or suburban towns, the schedules were unreliable, rates were arbitrary and sometimes unreasonable, and often, in case of a bus breakdown, the passengers were left to shift for themselves and get to their destinations as best they might.

One of the first uses of buses for longer runs was on scenic routes or tours. Their operation was profitable in this service, and bus lines gradually began to branch out in all directions, meeting and crossing each other, and continually expanding. As the public acceptance of them as a legitimate mode of travel became more general and profits began to show, consolidations were effected, the "wild-cats" and local transportation companies began to disappear gradually, and responsible companies which maintained schedule service over fixed routes at definite, more reasonable rates, took their place. Now practically every highway near the larger urban centers and in thickly populated districts, has its motor-bus line, while lesser highways and towns can also boast possession of one or more bus transportation companies.



Courtesy New York, New Haven and Hartford Railroad

PARLOR OBSERVATION COACH

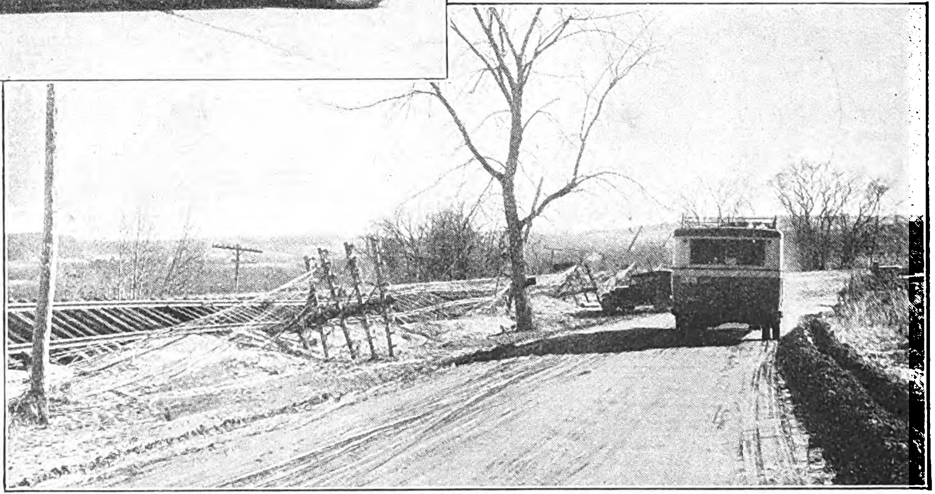
Under the elevated observation section of this motor bus is space for the luggage

Not only do present bus lines cross and re-cross each other, but many of them parallel rail lines in direct competition with steam railroads. This competition has been greatly extended in recent months by the inauguration of overnight lines, the buses of which are built somewhat on the order of a railroad sleeping car, with berths and all the appurtenances necessary for a continuous trip of several days' length. Such a bus was described in SCIENTIFIC AMERICAN, October, 1928.

With characteristic conservatism, the railroads for years looked askance upon the competing highway transportation lines. Private automobiles had already taken a great deal of business from the railroads and bus lines, if successful on any large scale, promised to carry many more former railroad passengers. Railroad officials became uneasy. Some thought that the railroad should stick to the rails and meet bus competition by better service while others believed that the railroads would, in the end, have to operate their own highway lines.

THE logical and, we might say, inevitable outcome was that many railroads decided to follow the latter course.

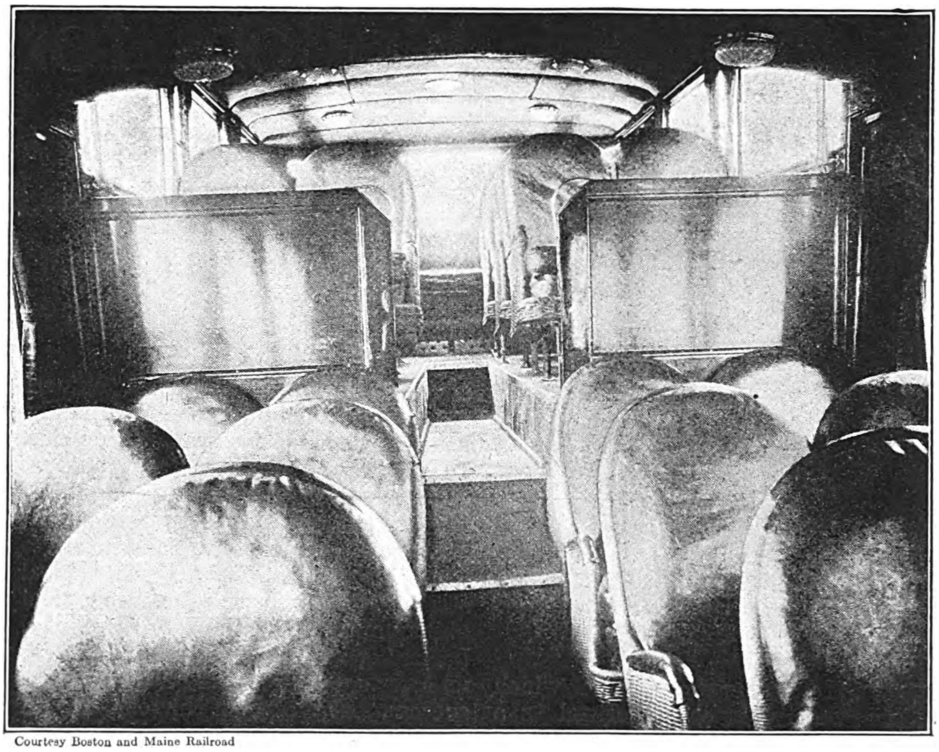
Thus in the United States, there are at present, according to "Facts and Figures of the Automobile Industry," published by the National Automobile Chamber of Commerce, 67 steam railroads using motor buses. Some of these are operated by the railroads themselves, others by subsidiary transportation companies formed and entirely owned by the railroads, while others are operated on contract by outside companies. The routes covered are: new feeder lines, lines substituted for unprofitable branch steam lines,



Courtesy Boston and Maine Railroad

THE RAILS ARE OUT BUT THE BUSES GO ON

During the flood of November 3-5, 1927, in New England, many railroads were washed out. Buses were running in a short time because the roads could be opened sooner than the rails


Courtesy Boston and Maine Railroad

THE OBSERVATION "PLATFORM" OF A DE LUXE BUS

The roomy interior and comfortable seating arrangement of a large motor bus showing the steps leading to the observation section in the rear. Buses of this type are used on long runs

and on highways paralleling rail routes.

The feeder service is exemplified by the bus lines operated by the Fifth Avenue Coach Company for the Baltimore and Ohio Railroad Company from the Central Railroad of New Jersey terminal in Jersey City to New York and Brooklyn. The parlor motor coaches on this line run from the trainside, cross on Hudson River ferries, past some of the larger, well-known hotels in Manhattan to the ticket office and waiting room maintained opposite Grand Central Terminal; and across lower Manhattan to Borough Hall, Brooklyn. Twenty-two buses are operated in this service which is run without extra cost to rail passengers.

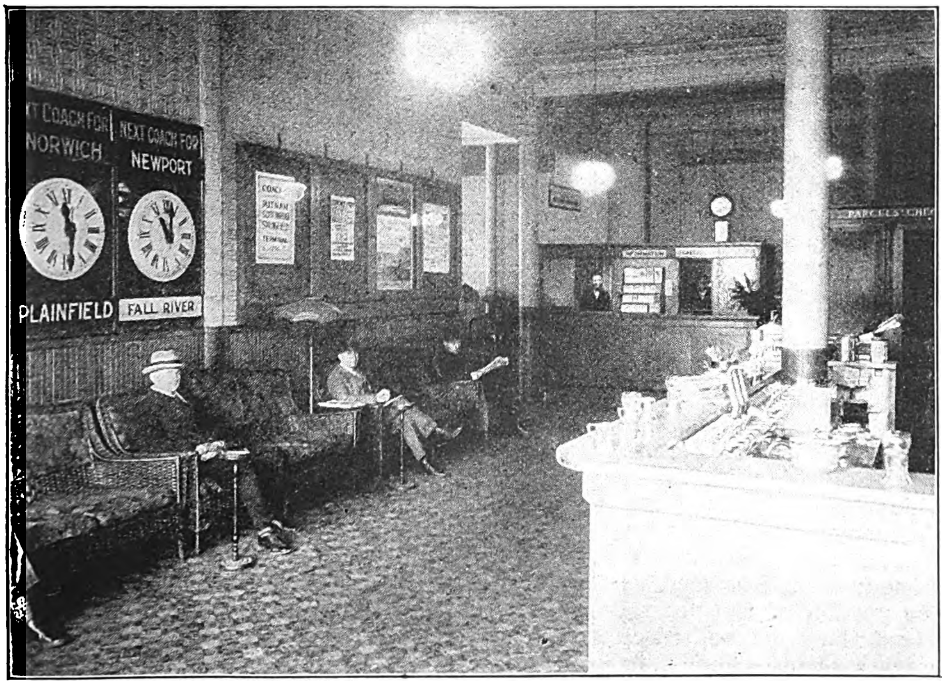
THE Boston and Maine Railroad reports that it operates 92 buses over approximately 1200 miles in Massachusetts, New Hampshire, Maine, Vermont, and eastern New York. For the first nine months of 1928, they operated 1,844,987 miles compared with 1,719,765 miles during the whole of 1927. These figures indicate that there is no slowing up of railroad-bus service but, instead, there is rapid growth. Their buses are used to eliminate stops of steam trains and thus speed up train service; for supplying service to communities formerly without service of any kind; for summer tourist service; to replace unprofitable street railway lines; and for special party work—in addition to feeder lines and substitution on branches.

The Reading Company now operates 30 motor buses on 11 lines which total about 255 miles—relatively a small system—but their annual mileage is 850,000 and their schedules number 184. This company uses motor buses for the purpose of maintaining frequency of service and to increase it where the traffic does not warrant such frequency by the steam trains. Its buses operate in co-ordination with the schedules of steam trains but are otherwise independent of rail lines.

The New York, New Haven, and Hartford Railroad Company, said to be one of the pioneers and also the largest railroad operator of buses in the east, now has a highway transportation system (subsidiary) that boasts 270 buses. Twenty-one of its 50 lines are classed as "rail savers," 23 as supplemental to rail, and six as summer lines. During 1927, its buses carried 4,248,287 passengers and were operated 6,682,355 bus-miles.

THE larger railroad operators of buses have regular time-tables, comparable in size and completeness with those used for regular steam trains; separate passenger ticket offices and waiting rooms; and their own garages and full-time salaried mechanics. Passengers for other lines, not necessarily the smaller, use the regular railroad stations. Usually, except in cases like that of the New York City feeder service of the Baltimore and Ohio Railroad Company, railroad tickets cannot be used on buses although the rate on the buses averages about the same as that on the steam trains, or 3.6 cents a mile.

In this discussion, only a few examples have been given to show the extent of highway transportation systems now operated by railroads and to show how the service rendered by these lines has grown from nothing in a matter of less than 10 years to an immense nation-wide business. It is sufficient to indicate the trend of thought among railroad officials and give a promise of what is to come. The success in this service, of the railroads mentioned here, and the fact that they and other far-sighted ones are continually adding to their fleets of buses, points conclusively to the fact that, in time, practically all railroads will operate buses in highway service.



Courtesy New York, New Haven and Hartford Railroad

LIKE A REGULAR RAILROAD STATION

Some of the larger railroad operators of buses have established waiting rooms and ticket offices for bus passengers. The station shown is particularly well-arranged and comfortable

Robots for Salesmen

Big Business Lays the Foundation for the Age of Mechanical Distribution of Merchandise

By MILTON WRIGHT

JOSEPH J. SCHERMACK

About this prolific inventor is built a 25,000,000 dollar corporation to install automatic vending machines everywhere

THE industrial era in which we live is characterized to a great extent by ever-advancing steps to relieve men and women of mere mechanical duties and leave them free to concentrate upon tasks which require thought. "If something can be done by machinery, let a machine do it," has been our motto for some years past.

That this is the keynote of our *industrial* progress is self-evident. It now becomes the principle for *commercial* progress. Why have a high-priced human salesman perform the mere mechanical task of handing out a package of cigarettes, receiving a quarter, dropping your money in a cash drawer and passing back to the customer ten cents in change, a paper of matches and a profit-sharing coupon? Why not have automatic equipment to do this automatic work, permitting the man behind the counter to induce the customer to buy a $2.50 pipe, thus being a salesman in fact as well as in name?

THAT is precisely what is now about to be done through an overshadowing 25,000,000 dollar corporation which has recently been founded, including in its affiliation one of the best known inventor's laboratories in the country, one of the best known arms' manufacturers, the leading chains of cigar stores, the vending machine manufacturers, and candy, drug, and novelty stores.

At the very center of this development, as at the center of most great developments, stands an inventor. In this case it happens to be Joseph J. Schermack, the man who has done more to make automatic vending machines a commercial success than has any other man in this country. Mr. Schermack is president of the new Consolidated Automatic Merchandising Corporation. Like many geniuses who have built up large enterprises he has become associated with a financier. In this case it happens to be A. J. Sack, who is Chairman of the Board of Directors of the new corporation.

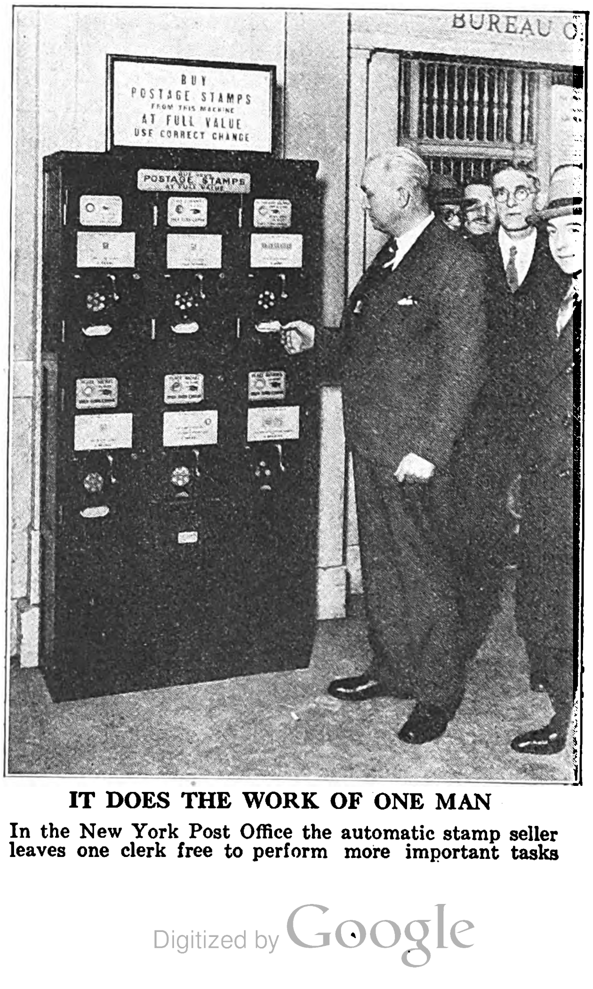
We called upon Mr. Schermack to learn his story. It was the typical story of the inventor with mechanical ability and business ability combined, beginning in humble circumstances at an early age and working his way up to success. At the age of thirteen, he had started to work as a mechanic in a factory in Freeport, Illinois. In 1900, he went into business for himself making mailing machines. The first of these he placed with Marshall Field and Company in Chicago.

Five years later, he developed the roll device for postage stamps such as is now used extensively in postage stamp vending machines. In 1910, he brought out the first commercially practical stamp selling device. Later, he transferred his business to Detroit. He developed and induced the government to provide the roll form of postage stamps, now in general use for commercial purposes in a variety of mailing and stamp selling machines.

"We have 30,000 commercial stamp-selling machines in operation in the United States, in hotels, drug stores and other places," Mr. Schermack told us, "and eventually we will have a hundred thousand. At first, we sold these machines outright to the stores in which they were used. Later, we abandoned this principle and placed them in the stores on a profit-sharing basis. Thus, in every Liggett's drug store we installed a machine, which the Liggett Drug Company keeps filled with stamps and collects the money; then they send us our portion of the profits. About the same method of operating will be applied to all devices controlled by our present consolidation. The ownership of the new merchandising machines is to be retained by our corporation."

We began to discuss the first of the new types of machines which the new corporation is bringing out. This is the slot machine which delivers a pack of cigarettes, a coupon, and a paper of matches and says "Thank you" to the customer who has dropped his money in the proper slot.

THE use of such machines, we learned, was a logical development of the cigar store business. There was a need to give more display room to the goods and at the same time more room on the counters to the salesmen. The cigar stores always were paying rent for both sides of the store but, heretofore, only one side has been doing any business; that is to say, a counter runs down only one side of the store. Officials of the United Cigar Stores estimated that 90 percent of their total business in any one of the stores is done at their number one counter.



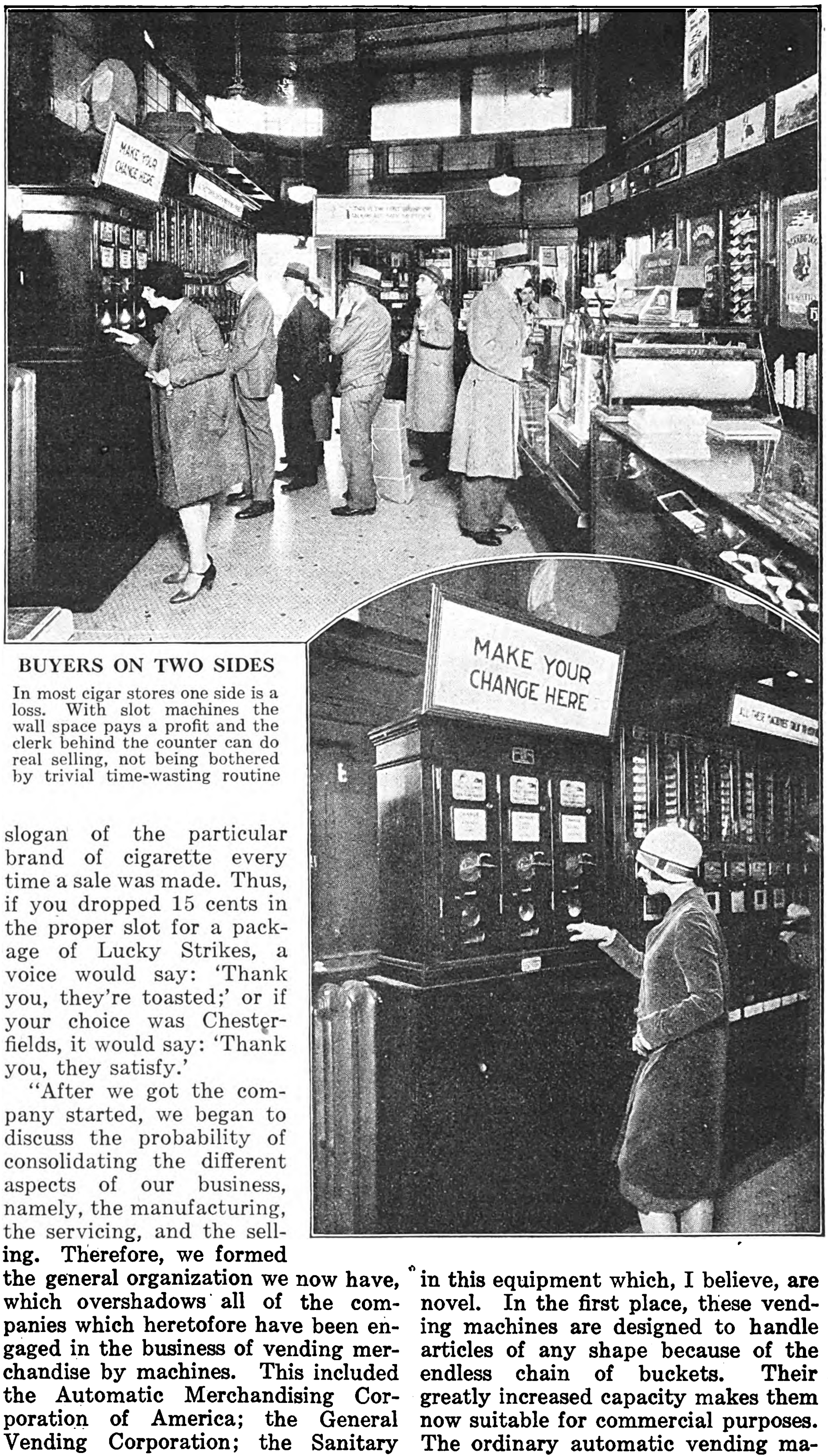
IT DOES THE WORK OF ONE MAN

In the New York Post Office the automatic stamp seller leaves one clerk free to perform more important tasks

While Mr. Schermack and Mr. Sack were thinking along these lines and planning for automatic machines to relieve the salesmen, the United Cigar Store officials were thinking along the same lines. Let us interrupt our interview with Mr. Schermack at this point and recall an interview with Mr. A. Granat, Vice President, United Cigar Stores Company, on the same general subject.

"Why could we not have a battery of vending machines instead of a lot of mirrors on the side of the store opposite the counter, was the question I kept asking myself," Mr. Granat said to us.

"We could put them in shadow boxes and light them up and customers would be attracted to them. The problem was to get the right kind of vending machines. For two and one half years I talked to all kinds of inventors and I got every conceivable kind of vending machine, except the kind I wanted. A gravity drop machine, for example, would not be effective because of the different sizes and weights of the packages. Then, too, all of the inventors wanted to be financed, while I was looking for someone who would finance his own invention.



BUYERS ON TWO SIDES

In most cigar stores one side is a loss. With slot machines the wall space pays a profit and the clerk behind the counter can do real selling, not being bothered by trivial time-wasting routine

"FINALLY, I got in touch with the Sanitary Postage Service Corporation. They came in with a proposition to put a coin-controlled vending machine in a cigar store at their own expense, which they estimated would not be more than 10,000 dollars."

"Why do you select cigarettes to put into these vending machines?" we asked.

"Because cigarettes are necessarily unprofitable. When you figure that the grower gets about six cents for the tobacco that would go into a package of cigarettes and that the consumer pays only fifteen cents, you can see that in that difference of nine cents out of which must come manufacturing cost, advertising, distribution, and everything else, there is not much opportunity for profit. Therefore, they were considered the logical thing to vend through the machines.

"We developed a machine and put it into a cigar store at 33rd Street and Broadway, New York City. I was in there one day to see how it would operate, when one of the customers in the store, a stranger to me, said: 'I suppose that will pass out the cigarettes all right, but I will miss the "Thank you" that the clerk always says when he gives me my change.'

"That was what was needed, a machine which could not only sell, but talk. We set to work on the machine and with the aid of one of the best-known manufacturers in the country we developed an apparatus which would say 'Thank you' and repeat the slogan of the particular brand of cigarette every time a sale was made. Thus, if you dropped 15 cents in the proper slot for a package of Lucky Strikes, a voice would say: 'Thank you, they're toasted;' or if your choice was Chesterfields, it would say: 'Thank you, they satisfy.'

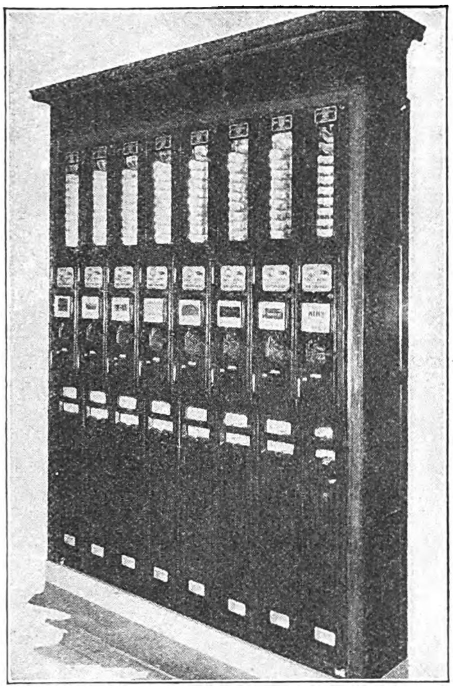
"After we got the company started, we began to discuss the probability of consolidating the different aspects of our business, namely, the manufacturing, the servicing, and the selling. Therefore, we formed the general organization we now have, which overshadows all of the companies which heretofore have been engaged in the business of vending merchandise by machines. This included the Automatic Merchandising Corporation of America; the General Vending Corporation; the Sanitary Postage Service Corporation, and the Schermack Corporation of America. The Remington Arms Company was already in the field as a potential competitor and we drew them into the fold."

Now to return to our interview with Mr. Schermack.

"Have you taken out any patents for these new talking merchandising machines?" we asked him.

"Nine patents are pending," he replied. "There are three main features in this equipment which, I believe, are novel. In the first place, these vending machines are designed to handle articles of any shape because of the endless chain of buckets. Their greatly increased capacity makes them now suitable for commercial purposes. The ordinary automatic vending machine has a limited capacity of 25 packages, while the endless bucket chain principle used in the present machine, permits a hundred packages to be loaded into the device, which will deliver not only the package of cigarettes, but also give certificates and matches and change, when necessary.

"Then the coin-control feature is novel also. It can handle from one to three coins of any denomination, exposing all of the coins, both before



READY FOR BUSINESS

A large capacity for each stack permits continuous operation without refilling

and after the operation. The nature of these coin controls is such that they are easily interchangeable for various amounts and denominations.

“In the one United Cigar Store in which we have installed the new type of merchandising machine, there are fifteen units for merchandise and change making.

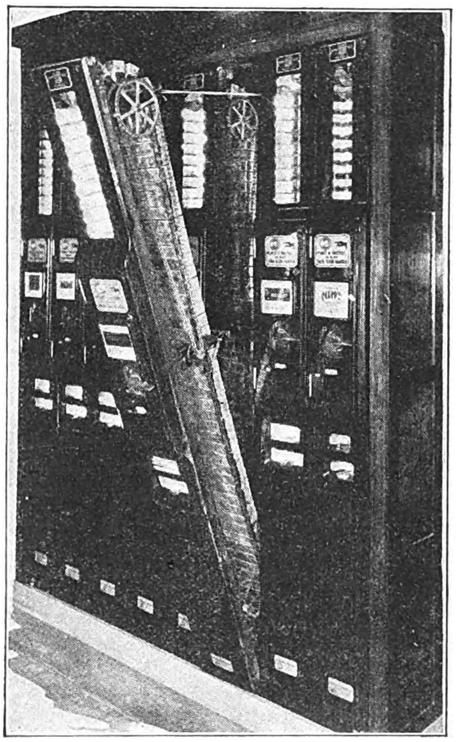
“The most interesting feature of our automatic merchandising system is the combination of talking and automatic vending machine, a combination no one, apparently, ever thought of until recently, and upon which we expect patents will be issued shortly.

“ANOTHER patentable feature which never seems to have occurred to anybody so far, is to have the phonograph needle travel in a circle on the phonograph disk instead of in a spiral. This permits endless repetition of the one brief message; the disk stops, then repeats when the next customer comes along. This idea of the circular movement instead of the spiral is simple in itself; yet, no one has thought of it. The patent claims on this we expect to be extremely broad.”

To complete our picture of the new enterprise we had a chat with Mr. A. J. Sack, the chairman of the Board of Directors.

“When I met Mr. Schermack in the early part of 1924, his accomplishments were already impressive,” said Mr. Sack. “He had invented and designed the well-known sanitary postage machine, and succeeded, by that time, in placing about eight thousand of them on the market, thus proving that automatic postage service, because of its convenience and cleanliness, is readily accepted by the merchants and the large buying public.

“I was further impressed by the marvelous preparatory work which he has done in applying the principle of automatic service to the large and important Post Office field. He invented a device, an automatic postage machine for Post Offices, which would sell, at cost, one cent, two cent and five cent stamps in various combinations, as well as stamped envelopes, stamps in book form, and postcards. In discussing this part of his work, I was deeply impressed by the meaning of this service which would not only relieve the Post Office pressure during rush hours, but would also serve the public in the evenings and on Sundays and holidays, when the Post Office windows are closed. In addition, it would save the Post Office Department millions of dollars yearly.



THE MECHANISM IS SIMPLE

With few parts and sturdy construction the slot machine does not get out of order

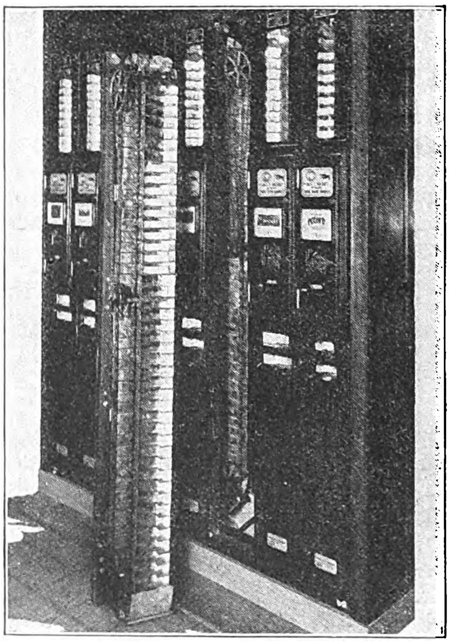
“As our relationships and friendship developed, we found ourselves in full accord as to the understanding that this country is entering the automatic age. Our relationships culminated in my accepting the position of Vice President and Executive Director in the Schermack Corporation of America and in the Sanitary Postage Association of America, for the purpose of helping in reorganizing these two companies and preparing them for proper financing.

“It took us two years, until March, 1926, to perform this preliminary work. We then organized the Sanitary Postage Service Corporation and brought in substantial capital. This enabled us to eliminate the outright sales of the sanitary postage machines and to adopt a policy of placing them free with the merchants, on a profit-sharing basis. The result was that where it took about eight years to sell 12,000 machines outright, it took us less than two years to place an additional 20,000 machines on a profit-sharing basis.

“What is still more important, we succeeded in placing the sanitary postage machines in such important locations as the United Cigar Stores; the Liggett Drug Stores; the Schulte Cigar Stores; the Owl Drug Stores, et cetera. Automatic postage service has thus become a national institution,

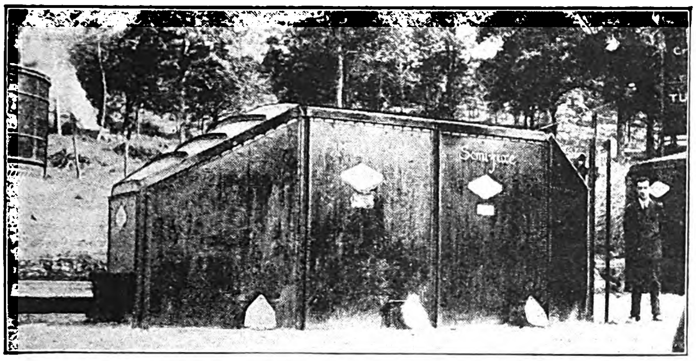
“TOGETHER with Mr. Granat and Mr. Schermack, and with the close participation of Mr. Nathan A. Smyth, Vice President and general counsel of our companies, we conceived a further step, and that is, the consolidation of the leading automatic enterprises in the field. It was then our good fortune to meet Mr. F. J. Lisman, of F. J. Lisman and Company, a banker who has been a member of the New York Stock Exchange for over 30 years and who, together with excellent maturity of judgment, preserves a wonderful, youthful attitude towards new ideas.

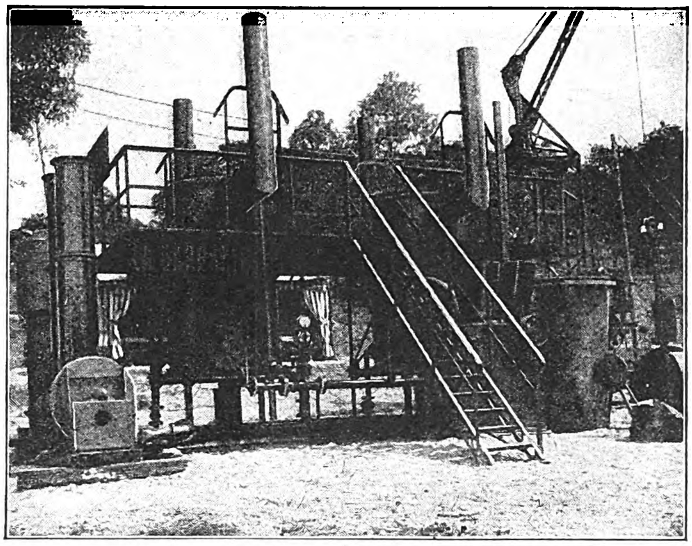
“With Mr. Lisman’s help, we organized the Consolidated Automatic Merchandising Corporation, which is a combination of our three companies —the Sanitary Postage Service Corporation, the Schermack Corporation of America, and the Automatic Merchandising Corporation of America— together with the General Vending Corporation and the Remington Service Machines, Inc. F. J. Lisman and Company have underwritten the issue, and the Consolidated Automatic Merchandising Corp. has become a fact.”



EACH STACK IS A UNIT

It may be taken out easily and quickly to get at the mechanism in the rear





THE "GAZOGENE" MANUFACTURING PLANT

Above is shown the Trihan kiln for burning wood to make charcoal and "gazogene." This type is important because it burns all sizes of wood whether in chunks, logs, or brush form. It is so constructed as to prevent leakage of the gas that is generated and also to prevent embers from flaming. The time of burning varies from 15 to 40 hours. The illustration at the right shows the plant for collecting the gases and condensing them into "gazogene"

Wood Gases for Motors

"Gazogene," France's New Gas, Promises to Replace Gasoline As Fuel

"GAZOGENE" TANKS

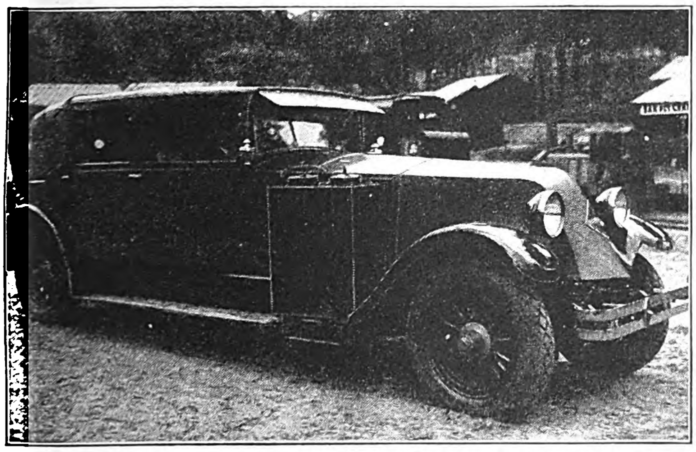
The tanks in which is stored the cheap new motor fuel that is derived from wood

WHEN wood is carbonized to make charcoal, great volumes of gases are thrown off and usually wasted. The problem of utilizing these gases as fuel for gasoline motors has occupied the attention of French scientists for several years. Ever since the first efforts were made, in France, to substitute the "gas of the forests"—which is called "gazogene"—for gasoline in trucks and heavy motors, strenuous efforts have been made to adapt carburetors to the use of this unique fuel. The pioneer researches of M. Breton, a member of the Academy of Sciences of Paris, in connection with "gazogene," have thrilled France with the possibility of making its own motor fuel.

Now, according to reports, equipment for the manufacture of "gazogene" has been perfected and carburetors and motors have been adjusted to use it. At the recent Forestry Exposition near Versailles, "gazogene" manufacturing equipment and several types of vehicle motors using it were shown. Prominent among these were a luxurious touring car and a truck.

Details of the process of manufacturing "gazogene" are not very clear but it is understood that the gases given off from the charcoal kiln during the burning are collected, passed through water to be cooled and condensed, and are then placed in containers that are later to be mounted on the vehicle. It is simply a process of distillation of the resinous substance of woods.

The collection of the gases has presented such a problem that several types of kilns have been developed. One of the most successful of these is the Trihan, a photograph of which is shown at the top of this page. This consists of a rectangular tank-like oven which is easily separable and portable. In position, the seams are leak-proof and the base is tightly sealed with earth. The cover is removed, it is charged with wood which is ignited at one end, and the gases are drawn off through partitions of heavy cloth. The gases given off are then passed through the condenser mentioned above and the "gazogene" collected.



TOURING CAR WHICH RUNS ON GAZOGENE

A Renault car which has been adapted to the use of the new fuel. The "gazogene" is carried in the container on the side of the car

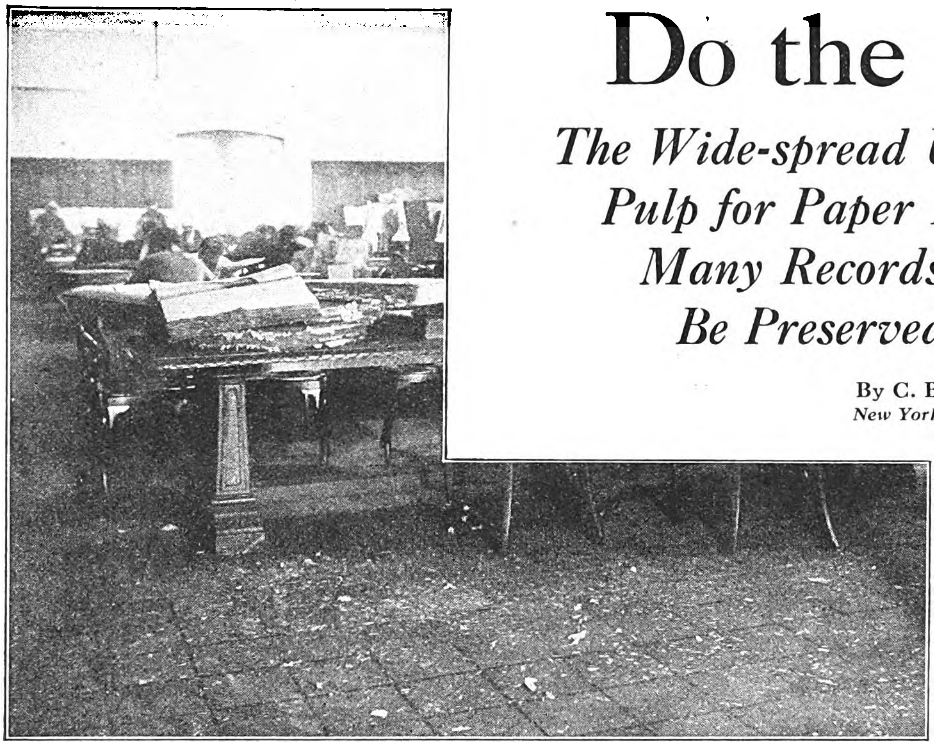
TRUCK ADAPTED TO THE USE OF GAZOGENE

A left-over American Army Liberty truck, with its container of "gazogene." The new fuel is said to be comparatively cheap

Do the Records of

The Wide-spread Use of Groundwood *Pulp for Paper* Has Endangered *Many Records* Which Should *Be Preserved* for Posterity

By C. BINKLEY
New York University



FRAGMENTS LITTER THE FLOOR

A part of the newspaper reading room of the New York Public Library is shown here. The floor has to be swept four times a day to remove the broken bits of deteriorated paper

THE 19th Century instructed us in what we call the scientific attitude toward history; it taught us the value of preserving records; it gave us to believe that an accurate understanding of all aspects of our past was essential to clear thinking upon the present. And having thus taught us the value and sanctity of all records, it began to print its records upon highly perishable wood-pulp paper.

No civilization since the invention of writing has entrusted its records to so fragile a medium as this wood-pulp paper. The bamboo strips upon which the sacred books of Ceylon are written, the clay tablets of Mesopotamia, the paper and silk of China, the papyrus of the old Mediterranean world, the parchment of medieval Europe—these materials had a life expectancy of centuries or millenia, whereas our ordinary newspaper print paper has a life expectancy of decades.

Egyptian papyri 2000 years old are in better shape today than some of the paper that went under the printing press during the World War. A manuscript from the time of Mohammed, written in Arabic on cotton-fiber paper, is still in a state of good preservation in the library at Leyden. The publications of the 15th Century look as if they may well last another 450 years; but many books and magazines printed in 1900 are rapidly disintegrating.

The art of making paper from silk, cotton, and linen fibers is about 2000 years old. The Arabs picked it up from the Chinese and introduced it into western Europe in Medieval times. Paper replaced expensive parchment in some of the manuscript book making of the 12th Century. The Emperor Frederick Barbarosa prohibited its use in deeds and charters, because he feared it was too perishable.

Then came the invention of printing. A great book industry grew up, revolutionizing European culture by making learning more accessible to the people. This book industry could not have developed from the invention of printing alone, because the great cost of parchment or vellum would have made books too expensive.

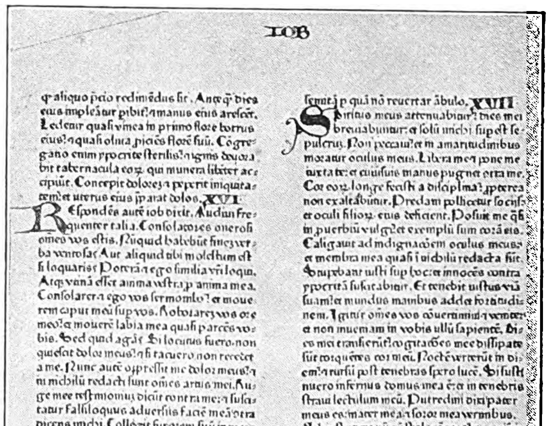
The paper-making industry was as essential to the new spread of learning as was printing itself.

AND the paper that was made in those centuries has stood the test of time. The Emperor Frederick's fears were unfounded. The paper charters have outlasted the legal rights founded upon them. And the books of the 15th Century are still with us.

In the third quarter of the 19th Century two discoveries of fundamental importance changed the basis of the paper industry. First was a machine for making paper on a continuous roll, which cut down the labor cost of paper making to a fraction of what it had been, and then cheaper substances came into use as raw material. Grass, straw, and wood were found to supply fibers which could be matted together as paper. The new paper was much cheaper than the old.

The chemical principles underlying the problem of paper deterioration are very simple. All paper is a felt made of fibers. If the fibers decay, the paper disintegrates. Some fibers are more likely to decay than others; they are, chemically speaking, more active. The most durable paper is one made of fibers which are most nearly inert. Papers are therefore to be valued in proportion to the chemical inertness of their fibers.

All of these fibers—cotton, linen, hemp, straw, grass, and wood—consist primarily of a substance known as cellulose. But wood cellulose contains constituent groups which are chemically active. Cotton, linen, and hemp are more inert. The disintegrating



PAPER FROM 1462

This is a photograph of a piece of rag paper, still as perfect as the day it was made, centuries ago

Science Face Ruin?

THE ancients left behind them records of great historical value to archeologists of the present day. Will we do the same for those who are to follow us? The ancients inscribed their writings on imperishable stone, vellum, parchment, and papyrus. We are printing ours on paper which, a few years hence will have disintegrated so as to be valueless to future historians.

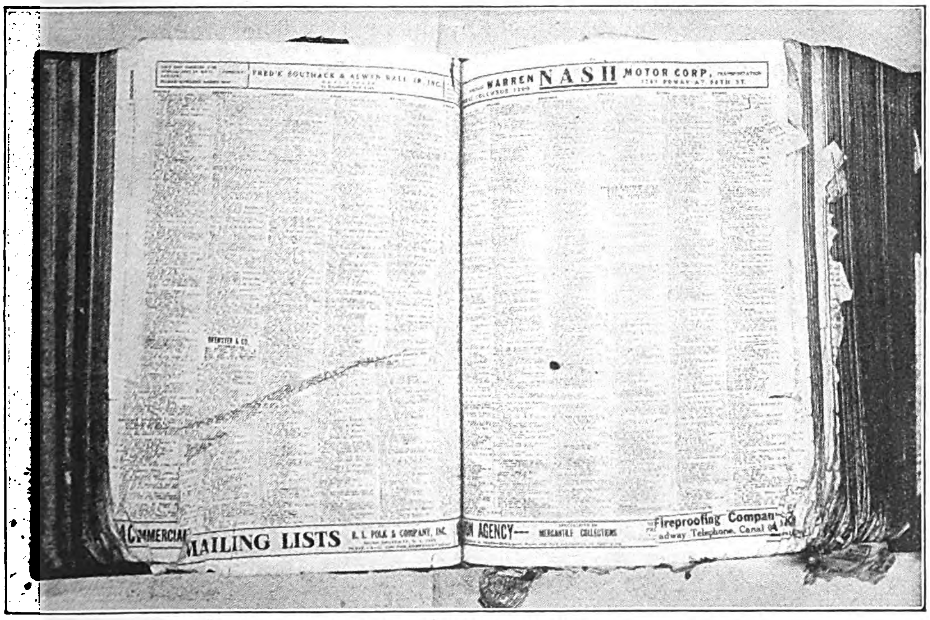
This state of affairs has been brought about by the great increase in the last two generations of the production of paper of a cheaper grade than was formerly available. What is to be done if we are to pass along to posterity the records of the knowledge of the present? In the accompanying article the entire situation is reviewed, and following it are the results of a survey by the SCIENTIFIC AMERICAN.—*The Editor.*

agency which operates most persistently upon wood-pulp paper is simply oxygen. That is to say, the decomposition of wood-pulp paper is chemically identical with the burning of a log in the fireplace, except that the process goes on at a lower temperature, and takes a longer time. In the presence of moisture or the fumes of gas, some papers may be attacked by acids left in them by the manufacturing process, or absorbed from the atmosphere. If the surface has been finished with gelatine, bacteria may sometimes attack damp paper. But the great enemy of paper is simple oxidation. Paper made from ground wood is powerless to resist this enemy. Paper made from rags of cotton, linen, or hemp will resist it.

THERE is danger that our interest in this matter may lie dormant until it is too late. But if we are to attack the problem while there is time to solve it adequately, the course to take is fairly obvious.

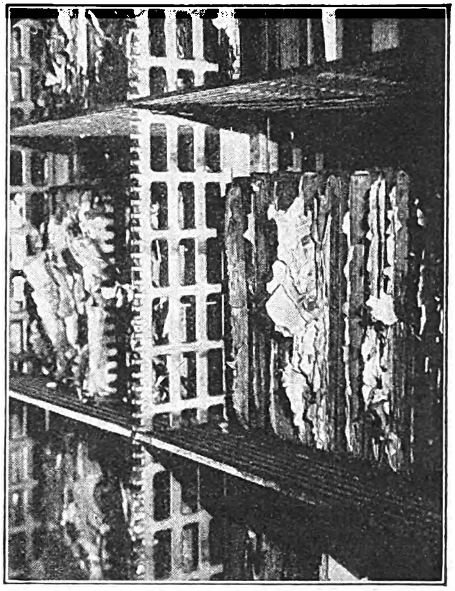
On the one hand we have to consider the printing that is being done today. Most of the copies of a newspaper, have fulfilled their purpose when they have been read. There is no sense in having them printed on any better paper than is now used. But a few copies of every publication—even of newspapers—should be printed upon paper that will last. Some publishers of books, and a few magazines publishers, bring out a special rag-paper edition. The New York *Times* took the lead among newspapers in this matter. This tendency must be systematized. If it is not possible to put rag-paper copies of a publication on sale, at least a few such copies should be made for office filing or copyright registration.

And then what are we to do with the fifty years legacy of decaying paper that now lies in our libraries? Here there are two general types of solution, both of which lie within the competence of modern chemistry to perfect and apply. On the one hand, an attempt can be made to preserve the existing paper stock by some treatment; on the other hand, a means can be found for copying the material which is on the printed pages, after which the existing volumes could be discarded.



ONLY TWO YEARS OLD

The raggedness of this two-year old copy of the New York City telephone directory is not entirely due to use. The paper has decomposed to such an exent that it breaks off



NEWSPAPER FILE

Bound volumes of back issues, showing the ravages of time on newsprint paper

Certain library methods are already in use which accomplish one or the other of these ends. The New York Public Library and the Hoover War Library have preserved certain important papers by pasting a sheet of Japanese paper over every page. This is an expensive process, and we do not know how effective it is, because it has not been long on trial. Another method of preserving paper stocks is the cellulose acetate spray, which permeates the paper stock and strengthens it by adding to its body. This method also has yet to stand the test of time.

IF we give up hope of saving the paper stock, we can copy off the reading matter upon stronger paper by the photostat method. The cost of materials precludes the large-scale use of this method. The suggestion is therefore made that photographic copying should be done on a reduced scale, to be read back again with a magnifying glass or by projection on a screen. It is chemically and optically possible to accomplish reductions of twenty or thirty diameters, which reduces the cost of photographic copies to less than the original purchase price, (except in the case of newspapers). The danger remains that the photographic film may itself prove perishable. Possibly photography upon metal plates may accomplish the desired result.

These possibilities must be explored. The whole problem must be systematically investigated. This skeleton must not remain indefinitely in the closet of modern scholarship.

The Scientific American Survey of the Problem

WHILE Mr. Binkley's survey is most interesting, it will be of more value if supported by further definite facts. We have gone into the subject

The World
ADMIRAL CERVERA AND 1,600 MEN OUR PRISONERS—
GEN. SHAFTER MAY TAKE SANTIAGO THIS MORNING
VICTORY!

SPANISH-AMERICAN WAR NEWS

Note how this 30-year old newspaper has deteriorated until its strength is gone

with the idea of presenting all sides. We have called upon the Forest Products Laboratory, the Bureau of Standards, and the Library of Congress.

The Forest Products Laboratory say that they have not investigated the subject but they have this to say:

"We note the use of the term 'wood-pulp' paper in Prof. Binkley's manuscript. While this is technically correct, it is misleading in that papers containing mechanically ground pulps are undoubtedly what are meant. Groundwood pulps and chemical wood-pulps have altogether different properties and the latter are perhaps about as permanent, if properly tested, as papers made from rag fiber. It is suggested that a distinction be drawn and that the term 'groundwood papers' be used in preference to wood-pulp papers, when the former is used.

"There is no question, of course, about the rapid deterioration of papers containing large proportions of groundwood pulps. However, there may be an undue prejudice against papers made from the purer forms of chemical pulps in favor of the rag fiber products."

THE Bureau of Standards reports: "While we have made some studies of the permanence of paper, we do not have at present enough information to make a definite statement concerning the relative durability of the various fibers used at the present time for making paper. We have recently initiated further research on this subject which we hope will lead to quite definite information.

"We are sending our present views and other information. (*Too long to re-print—Ed.*) You will note that where the greatest degree of permanence is required we recommend the use of the highest grade rag-fiber paper carefully prepared so as to contain minimum amounts of deteriorating agents. From theoretical considerations it would seem that such paper would necessarily have greater permanence than the best wood-fiber papers. At the present time, we agree with the opinion held by most investigators that the most durable paper fibers are those prepared from materials consisting of the purest forms of cellulose. As new white cotton and linen rags are a very pure form of cellulose, only slight chemical action is required to complete the purification of them. On the contrary, wood cellulose requires a very severe chemical treatment for its isolation and it seems reasonable to suppose that even if the cellulose obtained is quite thoroughly purified, the drastic purification process materially weakens the cell walls of the fiber elements so that they are in a more sensitive condition as regards mechanical stresses and possibly deteriorating agents than the rag fiber.

"IT is no doubt true that there are many grades of rag-fiber papers that are not more durable than wood-fiber papers. When the lower grades of rags are used, the chemical treatment required is fairly severe and no doubt the fiber elements are weakened as in the case of wood fibers. We believe that some of the present high grade wood fibers, especially those of considerable purity, such as the so-called alpha fibers, have considerable permanence, but it remains to be proven that they approach high grade rag fibers in permanency."

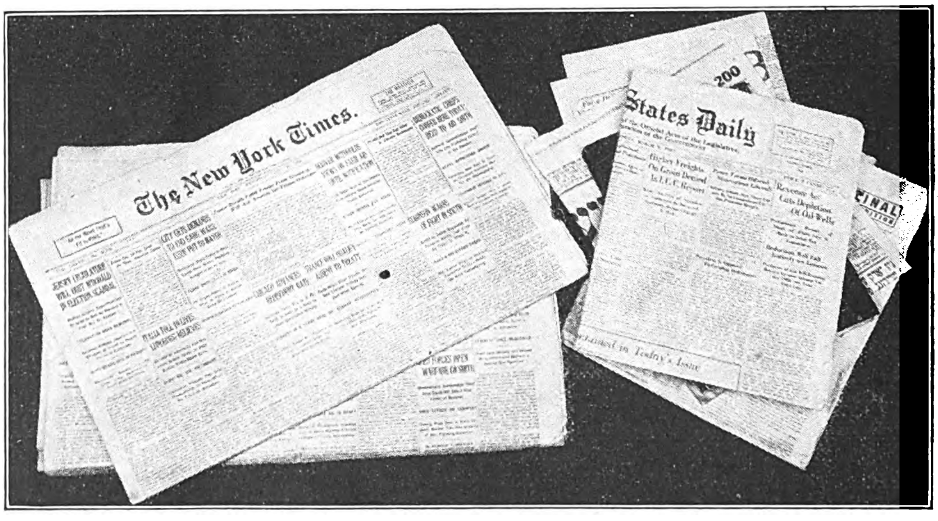
The Library of Congress is vitally interested in this subject and the officials sound a new note which deals with housing rather than manufacture. The Acting Librarian says:

"In approaching this problem you have probably given very careful consideration to the conditions surrounding the storage of the material in the book-stacks or other rooms, that is, ventilation, percentage of moisture in the air admitted, degree of temperature of air, screening of air of impurities before admission, et cetera, et cetera, (and the air of certain localities is heavily laden with gas fumes, et cetera). In storing our publications, we have always stressed these points as of the utmost importance, and as scientifically worked out, in relation to our material, they have contributed much to the preservation of our publications."

DR. TH. BENTZEN, a well-known paper chemist of long experience, says in "Technical Association Papers" of the Technical Association of the Pulp and Paper Industry: "The whole question in this paper is the rags. The question is, is it possible to make absolutely permanent paper, or a paper as permanent as you can make it out of rags, if you use sulfite pulp? We must remember that when we are talking about rags it means first-class, new, good rags. Compare with that the first-class sulfite pulp.

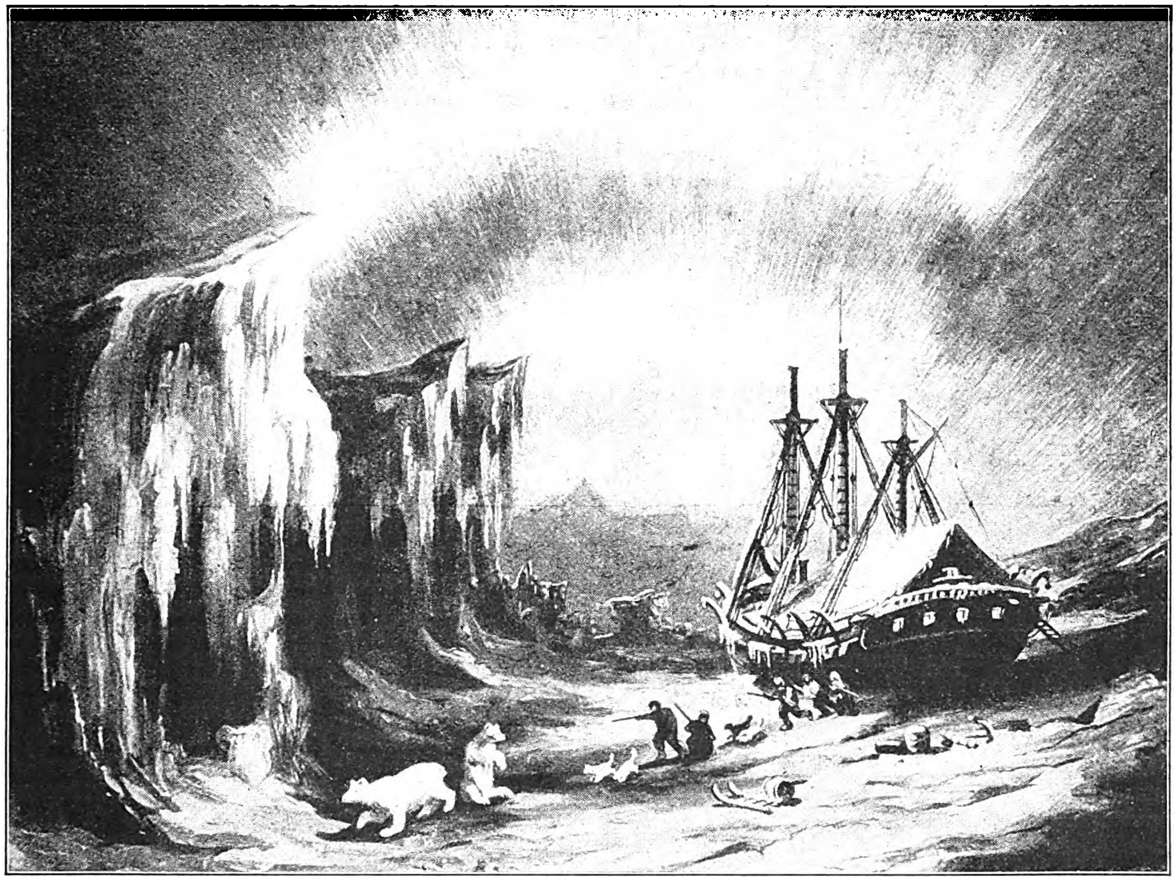
"Some people say if we make sulfite pulp as good as possible and wash it out, it is as good as old rags. That may be, but is it as good as new rags? That is the question. It would be, of course, a high-priced paper if we should make a paper the way we made it in the old days, but for certain uses to which that paper is to be put, for documents and records to be put in libraries to stand for centuries, there is no other way, as far as I can see, than to go back to the old way—wash the stuff out and use the very best."

Only about 2½ percent of the paper made in the United States is rag paper. We have not had chemical pulp paper long enough to pass an authoritative opinion; 60 years is a small part of the life of a printed book. All books and periodicals of more than ephemeral value should have at least library copies put on rag paper or on a very high grade chemical pulp paper. The problem is one of great gravity.



RAG-PAPER EDITIONS

Some newspapers and at least one magazine have a rag paper edition for those who want permanence. Subscription to New York *Times* rag-paper edition is 170 dollars a year



THE AURORA BOREALIS—FROM AN OLD PAINTING

It is only recently that scientists have made appreciable headway in solving the interesting problems connected with the aurora. There is little reason to doubt that it is caused by electrons shot out into space from sunspots, although not all sunspots cause auroras. Much yet remains to be learned

The Mystery of the Green Line

The Aurora Borealis Has Long Provided Science With One of Its Most Difficult Puzzles. This Problem is Now Giving Way Before Intensive Research

By J. C. McLENNAN, Ph.D., D.Sc.
Director of the Physical Laboratory at the University of Toronto
Fellow of the Royal Society

THE beauty of the aurora borealis when it is seen in its full glory in the far north has always impressed those who have witnessed the display, and it has excited many to search for the true nature and cause of the phenomenon. However, for a long time it remained one of the mysteries of nature, and it is only within recent years that scientists have commenced to understand what the aurora is and how it arises. The problem is not yet entirely solved. The following paragraphs present some established facts, and some of the most reasonable suggestions.

Figure 1 shows a pair of photographs of the aurora taken at the same instant from two observatories in Norway some miles apart. They show the most usual form of the auroral display as it is seen in Europe or America—a curtain of streamers, usually greenish white in color. This is the appearance which is familiar to most people, since it is only in the thinly populated regions of the far north that the full display appears, when at times the sky is filled with green and pink drapery.

THIS form of the phenomenon, which might be considered as the aurora proper, occurs at irregular intervals, and evidently only when some special condition exists. However, it has recently been discovered that, on any clear night, in any latitude, the whole sky is glowing with a faint green light which we now know to be allied to the aurora, and which must therefore be considered at the same time.

The slightly different shapes of the two views of the display in Figure 1, and their different positions against the background of the stars are shown clearly. By taking two simultaneous photographs like these from different places, the height and true direction of the streamers can be calculated. A great number of such pairs of photographs have been taken of auroral displays, especially in Norway, by Professor Stormer, and the actual places from which the light is coming have been determined. In this way it has been learned that the region in which the aurora takes place is from 50 to 500 miles and more above the surface of the earth, with its greatest frequency and brilliance at a height of about 60 miles. At this height there are about one hundred million million molecules of gas per cubic centimeter, which is about one one-hundred-thousandth of the density of the air at the surface of the earth, and about one one-hundredth of the density in an ordinary gas discharge tube.

By actual human experience we know the conditions of the atmosphere only to a height of nearly eight miles above the earth's surface, the greatest height ever reached by an airplane. By means of small balloons carrying self-recording instruments the exploration has been extended to a height of about 14 miles. As to the conditions existing above this height, there is no direct information. We know for instance that the temperature of the air falls as we go up until at a height of seven or eight miles it is about 70 to 80 degrees, Fahrenheit, below zero. Then a layer is reached in which the temperature remains constant as high as records have been secured. What happens above the 14-mile level? Does the temperature remain at 80 degrees below zero to the top of the atmosphere? Or is there another change? Now that scientists are beginning to understand the processes involved in the production of the aurora, a study of this phenomenon will give us the best means of determining conditions in the upper atmosphere at heights to which no balloon can ever hope to penetrate.

IN the general study of the frequency and distribution of the auroral displays it was very soon noticed that the occurrence of the phenomenon is frequently accompanied by a "magnetic storm." The magnetic field of the earth is disturbed, as is shown by the behavior of the compass, and stray magnetic effects in the atmosphere give rise to static on the radio, and sometimes even effect land telegraphy by causing stray induced currents in the wires. This suggests that there is actually an electric current involved in the streamer form of the aurora, and it is now believed that these streamers of luminosity are due to streams of electrons which cause the upper atmosphere to glow just as a discharge tube glows when a current of electricity passes through it. Professor Birkeland has calculated the paths which would be followed by such streams of electrons as they come under the influence of the earth's magnetic field, and has shown that they would follow very closely the course of the streamers of an auroral display.

For the most probable source of these electrons we find we must look to the Sun. There is a very definite distribution of auroral displays in time as well as in space. The number of displays per year varies from year to year in such a way that about every eleventh year there is a maximum of auroral activity. It is known that the number of spots on the Sun also varies from year to year with a maximum every 11 years. A long series of observations of sunspots and aurorae has shown that this is not mere coincidence, and that the maxima occur at the same time. There must therefore be some connection between the aurora and the kind of activity which produces the sunspots and prominences on the Sun. It has been suggested, and probably correctly, that the Sun gives off streams of electrons at such a time of activity, and that some of these electron streams strike the earth's atmosphere and excite the molecules there to emit the light of the aurora. Such electrons would all be stopped in the upper layers of the atmosphere, and so the aurora does not appear below the 50-mile level.

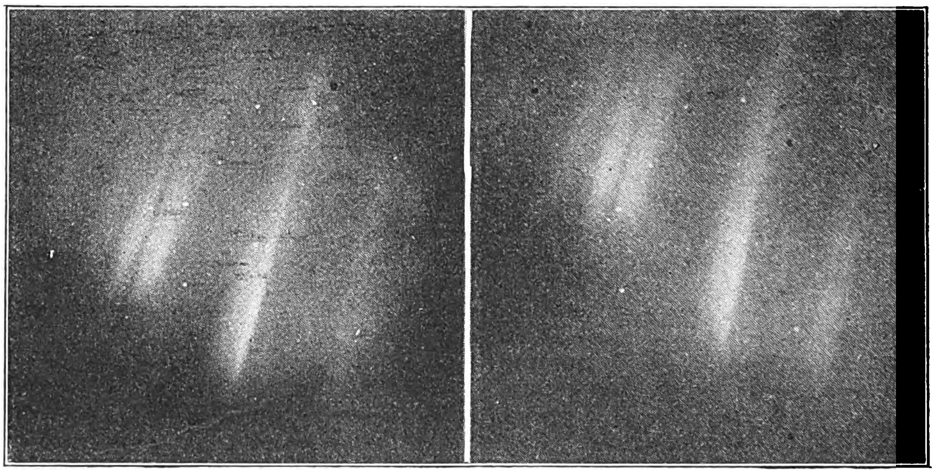
THE ever-present green light of the night sky may possibly be due to the same cause or to electrons from a source other than our Sun, but it is more likely in this case that the atoms are excited to emit the light by ultra-violet radiation of short wavelength which must be emitted by the Sun, but which cannot penetrate the denser lower layers of the atmosphere.

Just as the best, and almost the only, way of learning anything about the constitution of the stars is by analysing the light they give out, by means of a spectrograph, so, in the case of the aurora, the best way of using it to study conditions in the upper atmosphere is to study the spectrum of the light it emits. Figure 2, at bottom, is a reproduction of the spectrum of the auroral streamers; in Figure 3 is the spectrum of the light from the sky on a clear, moonless night (with the spectrum of iron for comparison purposes). The spectrum of the auroral streamers consists of a number of bright bands shaded towards the violet end of the spectrum, and one sharp strong line in the green at wavelength 5577A, the so-called "auroral green line." The spectrum of the clear night sky shows only the one line at 5577A.

Figure 2, at top, is the spectrum of nitrogen gas in a discharge tube, showing the "negative bands," 3914, 4278, 4708A, which are clearly the same as the bands in the spectrum of the streamers. Another group of bands, the "positive bands" of the nitrogen spectrum, have also been found in the spectrum of the aurora, but very faintly as compared with those shown in the reproduction. This shows that nitrogen must be a prominent ingredient in the region where the auroral light originates, and as there must be nitrogen in the upper atmosphere, we have further evidence for supposing that the aurora is a form of gas discharge in the region above the 50-mile level of the earth's atmosphere.

THE line at wavelength 5577A, which is such a prominent feature of the spectrum of the aurora, was a complete mystery for a long time. Nobody succeeded in reproducing it in the laboratory, and so no one could say to what element it belonged, until in 1925 its origin was shown by the writer, in collaboration with Dr. Shrum at the University of Toronto, to be traceable to gaseous oxygen. This remarkable line in the spectrum of oxygen shows great variations in intensity when the conditions under which it is excited are varied. Helium or neon when mixed with the oxygen enhances the line, and argon does the same thing to a very much greater extent. The spectrum obtained with a mixture of oxygen and helium is shown in Figure 3. The line of wavelength 5577A, it will be seen, is brought out very distinctly, accompanied, however, by lines due to helium, and by other lines of the ordinary spectrum of oxygen. Very careful measurements of the wavelength have shown beyond any possible doubt that this oxygen green line is the same one as appears in spectra of the aurora and of light of the night sky.

It appears, therefore, that the spectrum of the aurora can be accounted



A SIMPLE PROBLEM IN TRIANGULATION

Figure 1: The same aurora, photographed at the same instant from two separate stations, will show against an altered background of stars. From these data, the elevation is calculated

for by the presence of nitrogen and oxygen in the region where it originates. However, only certain parts of the ordinary spectra of these gases appear in the spectrum of the aurora. In the case of oxygen especially, why is it that we find only one spectral line, and that line one that appears only faintly in the spectrum of oxygen electrically excited in a discharge tube? A consideration of this question in the light of our present knowledge of the origin of spectra in general, supplemented by experiments now in progress in Toronto and elsewhere, will eventually shed much light on the conditions in the upper atmosphere.

We know that by gradually increasing the amount of energy which is supplied to the atoms or molecules of a gas, they can be made to emit more and more of their spectra. The amount of energy which is required to excite any particular portion of the spectrum is usually expressed by means of the "excitation potential," which is the number of volts that will make an electron travel with sufficient kinetic energy so that when it strikes the molecule the light required is emitted.

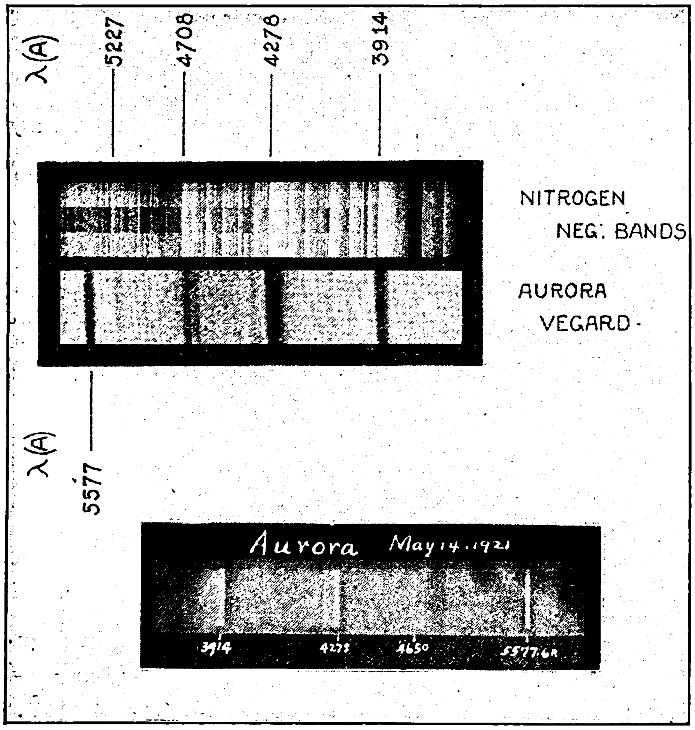
The "negative bands" of nitrogen, which appear so prominently in the spectrum of the auroral streamers, are due to ionized nitrogen molecules; that is, to molecules which have lost one electron, and their "excitation potential" is about 20 volts. The "positive bands" are due to normal nitrogen molecules and can be excited by more slowly moving electrons. These "positive bands" appear, although faintly, in the auroral spectrum, but the line spectrum of the nitrogen atom, which requires considerably more than 20 volts, does not. The streamers of the aurora, therefore, are apparently due to electrons which are sent out from the Sun and strike the upper atmosphere with an effective velocity corresponding to a little more than 20 volts. They appear to be sent out in more or less concentrated streams at irregular periods of special solar activity.

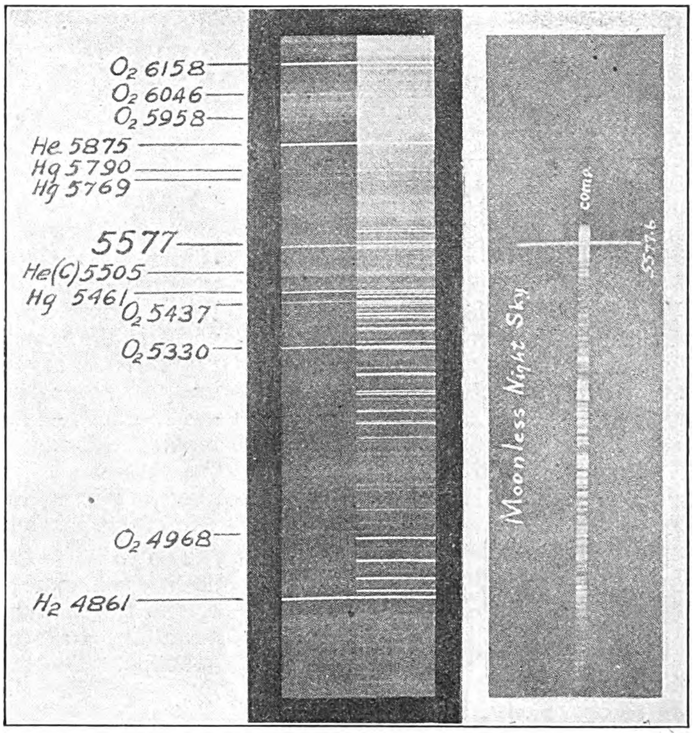
ON the other hand, the radiation of wavelength 5577A which comes to us from the night sky and appears to be emitted at all times and in all localities, must obviously be due to some other agency, and to something with less energy than the 20 volts required to produce the "negative bands" of nitrogen. Even the lower voltage required to produce the positive bands of nitrogen fixes an upper limit to the amount of energy required. The exact place of the spectral line 5577A in the scheme of the oxygen spectrum was definitely determined only very recently. Since it is a sharp line it must be due to the dissociated oxygen atom, and not to the molecule. It is known that oxygen readily dissociates into atoms by ultra-violet light of wavelength approximately 1750A and also that solar radiation of wavelength 2070A when absorbed by oxygen transforms the latter into ozone. Finally solar radiation of wavelength about 3000A, on being absorbed by ozone, re-transforms the latter back into oxygen. With such processes going on it is clear that in solar radiation we have an agency capable of furnishing an ample supply of oxygen atoms in the upper atmosphere.

Moreover, recent investigations have shown that atoms of oxygen can exist in any one of three states, of which one is stable and two are metastable. Energy relations that apply to the matter indicate that the atoms of oxygen are in one of these metastable states when they emit the light of the auroral green line, that heretofore mysterious part of the aurora's spectrum.

The state of the oxygen atoms immediately after their emission of this light has also been quite definitely ascertained. The investigations just completed on the magnetic resolution of the green line furnish the information that clears up this point and a few others that were somewhat obscure. We know now, beyond conjecture, how it comes about that oxygen in the upper atmosphere can be made to send out the light of the auroral green line that reaches us continuously from the night sky.

Spectrum analysis has recently enabled us to clear up the mystery that has long existed in men's minds regarding the origin of the light sent out by nebulae. We have learned that this light originates in highly ionized atoms of oxygen and nitrogen in metastable states. The puzzle as to the origin of the famous "green line" radiation, the most important and characteristic feature of auroral spectra, has also been solved. The auroral green light is emitted when oxygen atoms pass from one of their metastable states to the other.





SPECTRUM OF THE AURORAL STREAMERS

Figure 2, top: Spectrum of nitrogen gas in a discharge tube, showing the negative bands. *Bottom:* Spectrum of the auroral streamers

Figure 3, left: Spectrum obtained with a mixture of oxygen and helium; note line 5577. *Right:* Aurora spectrum on a moonless night

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Artificially Ripened Celery

ETHYLENE gas is used in industry to hasten the ripening of fruits and vegetables. It is one of the most popular anesthetics used in American surgery, replacing to a considerable extent the use of ether, chloroform, and nitrous oxide. Some investigators have been concerned as to whether or not the rapid ripening of fruits and vegetables by this means would not interfere seriously with their content of vitamins.

Dr. M. F. Babb, working in the University of Maine, undertook experiments with ethylene in the ripening of celery. He tested the celery ripened by ethylene as compared with celery ripened in the natural manner. Young rats of the same litter which weighed about the same amount were put on a diet free from vitamin B. Under such a diet the animals develop symptoms which are definite evidence of vitamin B starvation. These animals were then fed with ethylene ripened celery and with that ripened in the natural manner. The results indicated that artificial ripening with the gas is not injurious to the vitamin B content of the celery.

The results with celery cannot be taken as a generalization to be applied to the effects of ethylene on all other fruits and vegetables. Tomatoes are also being artificially ripened by ethylene, and oranges are being given a rapid coloration by exposure to this gas. It will be worth while to discover whether the ethylene ripened tomatoes can compare with sun ripened tomatoes in vitamin content, and whether or not the oranges are injured in any way by the artificial method.

Bakelite in Industry

EACH time a new product is brought into industry as, for example, Duco paint or Bakelite, or ethyl gasoline, questions at once arise as to the possible dangers to human health from the use or handling of the new substance. Bakelite is a synthetic resin or condensation product formed by the combination of phenol and formaldehyde. Each of these substances is in itself highly irritating to the human skin. Phenol gangrene is a common condition and has frequently resulted from the use of even household products containing phenol compounds. Formaldehyde is an irritant substance which may produce severe redness and inflammations of the skin. Knowing these facts, the manufacture of Bakelite is carried out in an enclosed apparatus. Through carelessness, however, it is quite possible for the substance concerned to come in contact with the skin of workmen and to produce severe irritations.

In the second phase of Bakelite manufacture, the resin made in the enclosed process is manipulated as a dry powder or as a liquid resembling varnish. In this work industrial alcohol or benzene may be employed. Deaths from benzine poisoning are already recorded. Moreover, numerous cases have occurred of irritation of the skin from benzine, which acts as an irritant by dissolving the fat from the skin and thus making it hard and brittle.

When Bakelite powders are made up into hard objects, the phenol-formaldehyde resin powder is diluted with a filler, used to an extent of 10 percent. This filler is usually a drug known as hexamethylenetetramine, used in medicine in infections of the bladder. It is a skin irritant, and in the presence of heat and perspiration may bring about irritations of the skin of workers with Bakelite.

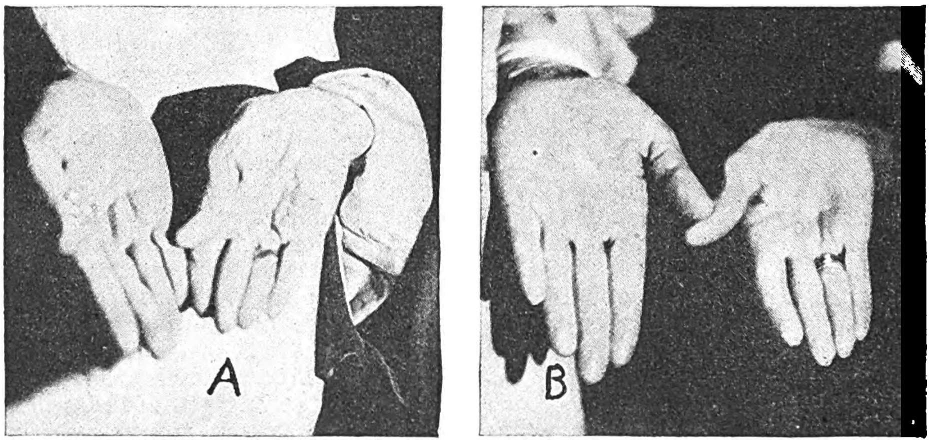
The brief consideration that has been given to this problem is significant of the thought that must be given nowadays to every new process in industry. The human being is sensitive to many foreign chemical substances and modern scientific industrial medicine has as its main task the prevention of industrial diseases in workers with dangerous products.

Duke's Palm Color Test

ONE of the important factors for determination in relationship to the changes occurring in health and disease is the state of the blood both as to the number of the red blood-cells and the amount of red blood coloring matter in the cells. There are many scientific methods for determining exactly how many red blood-cells there are and exactly how much red blood coloring matter may be present.

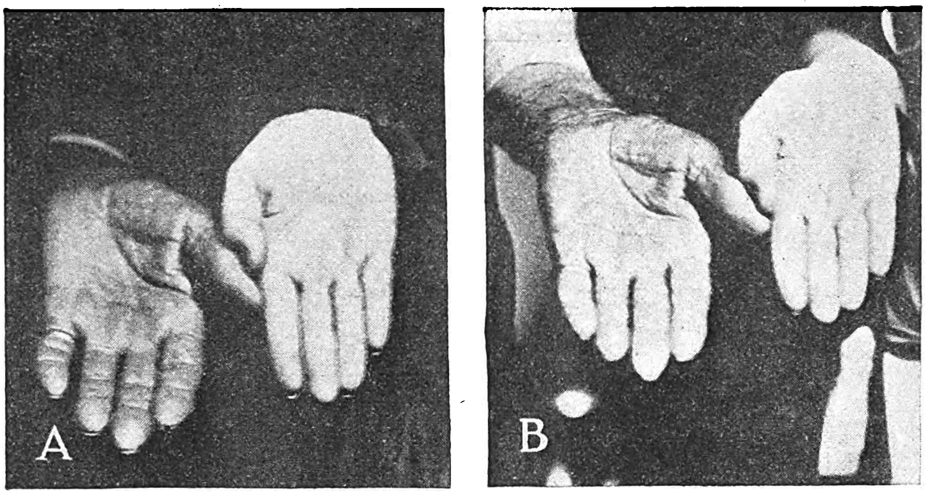
All of these methods involve the use of considerable apparatus and delicate manipulation by trained technicians. Dr. W. W. Duke believes, however, that slight or marked grades of anemia, which is an insufficient amount of these important substances, or of plethora which has to do with excessive quantities, can be determined readily in many cases by comparing the color of the palm of the hand of the person concerned with that of a person known to be normal.

He finds that the color of the palm is remarkably constant—much more so, in fact, than the color of other surfaces of the body, probably because it takes a smaller part in regulating the loss of body heat. It may



DUKE PALM COLOR TEST

A shows the palm of a woman with pernicious anemia (on the right); her weight was 85 pounds. The red blood-cell count was 1,180,000; the hemoglobin, taken in sunlight, 50 percent. *B* shows her palm after the introduction of 1200 cubic centimeters of blood; the red blood-cell count was 3,370,000; the hemoglobin, 80 percent. Note that in spite of persistent low red blood-cell count, the color of palm was restored to very nearly normal be desirable sometimes to know promptly whether or not blood changes have occurred—for example, immediately after a blood transfusion has been given. Doctor Duke submits pictures revealing the changing color of the palm under various circumstances.



ANOTHER PALM COLOR TEST

In *A*, the palm on the left is that of a patient with true polycythemia and a red blood-cell count of nearly 8,000,000. In *B*, note the paling of the palm following the withdrawal of 2000 cubic centimeters of blood in divided doses. The red blood-cell count was eventually reduced to nearly normal, with marked improvement in the general health of the patient observed

Danger of Lead Poisoning from Indelible Pencils

IN several instances in which portions of indelible pencils have been forced into the human body through accident or otherwise, serious symptoms have resulted. In one case, splinters of the pencil were forced into the hand of a worker. Five weeks later he had severe intestinal troubles with jaundice, and three and one half months later swelling of the hand with pain and disturbance of the kidneys. An operation for the removal of the indelible material resulted in eventual recovery.

When portions of the indelible pencil get into the eye, there may be severe inflammation with secondary infection, and sometimes even destruction of the eye. For this reason, it is absolutely important to avoid getting fragments of the indelible pencil into the eye while it is being sharpened.

The lead of indelible pencils in common use at this time is composed of graphite, kaolin, and some aniline dye stuff with methyl violet. Linseed or cottonseed oil may be used as a binder.

The makers of indelible pencils are exposed to a variety of hazards associated with the contact of the chemical components with the human skin. In addition to the aniline dyes, there are acrolein, formed on the heating of oils in the baking process, the glue, and the paint.

Industrial Skin Diseases

IN 1700 Ramazzini, referred to as the "father of industrial hygiene," made the first real contribution to a study of the diseases of the skin associated with occupations. He described the type of inflammation that occurs in washerwomen, bakers, farmers, and practitioners of many other trades. Dr. Harry R. Foerster has recently summed up our knowledge of industrial skin diseases. These result not only from such physical causes as heat, light, and rubbing, but also from pressure and compression, from cold, from irritating chemicals, from oils, and from many other substances.

Irritation or breaking of the skin gives opportunity for germs to get under the skin and to break down the tissues. Already many states have passed laws protecting the worker in industry who becomes infected as a result of the industry. The specialists who are anxious to prevent these diseases urge frequent cleansing with soap and water, frequent changes of dust-laden, and oil-soaked clothing, the use of grease on the hands and arms during work with dangerous chemicals, the abolition of dangerous paint solvents, and the provision of personal towels and cleansing rags instead of roller towels and the exchange of personal towels.

Persons with specially sensitive skins or those subject to skin diseases should be controlled when engaged in general industry. The moment a worker develops a skin disease he should be taken from the work until the condition has been properly diagnosed and safely controlled. Several famous hospitals and institutions have already established special clinics for the study of industrial skin diseases.

Irradiated Ergosterol

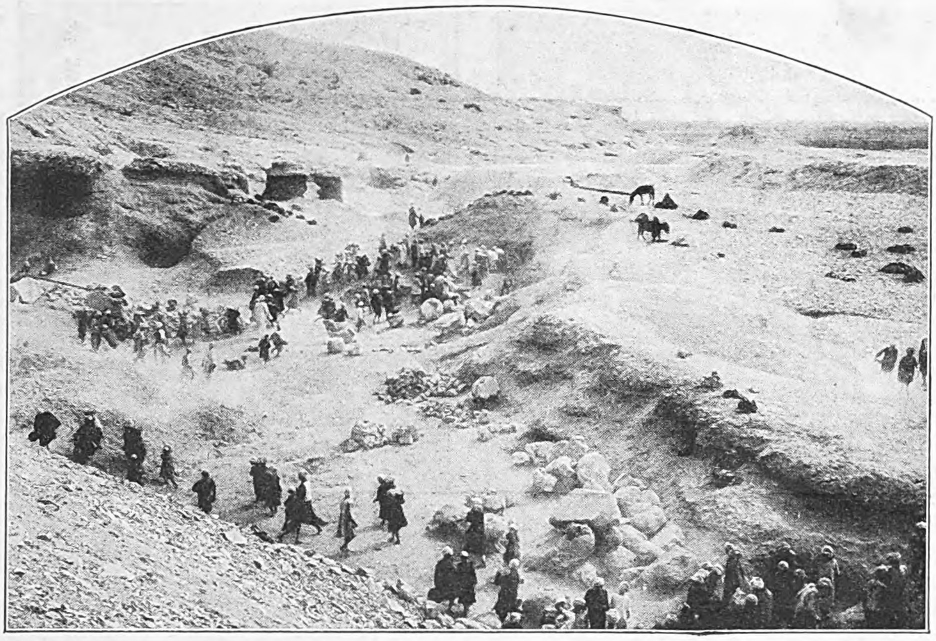
AS soon as it became definitely established that rickets can be prevented by exposure to ultra-violet rays or by the use of cod-liver oil, the chemists began to search for the constituent in the cod-liver oil which was responsible for the same effect as the ultra-violet rays. It has been definitely established through the experiments of Windaus and Hess, and of Rosenheim and Webster, that a substance known as ergosterol, associated in the human body with cholesterol, is activated by the sunlight to produce vitamin D, and that it is the vitamin D which is the important substance in the prevention of rickets. It has been shown by Hess and by Steenbock that various foods, such as oils, milks, and cereals can also be given specific anti-rickets properties merely by subjecting them to the ultra-violet rays of the sun or those obtained from some artificial source.

Ergosterol which has been submitted to ultra-violet rays is apparently the most highly potent substance against rickets that has thus far been developed. It is one hundred thousand times as powerful as cod-liver oil and is able to prevent or cure rickets in rats in a daily dose of one twenty-millionths of a gram. Since the announcement of these discoveries, preparations of irradiated ergosterol have been prepared and are being offered commercially to the public in many places.

Experiments with the substance in the prevention of rickets have been undertaken by Hess and his colleagues. As a result of the administration of this substance, the calcium in the blood is increased greatly, apparently without severe harm to the infants to whom the product was given. The phosphorus content of the blood is also increased. Foreign investigators in an attempt to determine what might be the dangerous dose, gave tremendous amounts of the irradiated ergosterol to rats and found that an amount equivalent to ten thousand times the minimum curative dose might cause calcification of some of the tissue of the body.

In two cases in infants, symptoms considered not especially desirable developed with high percentages of calcium. Indeed, the physicians are of the opinion that these symptoms are similar to those that follow an overdosage of ultra-violet rays, either from the sun or from some artificial source.

At present, most of the preparations of irradiated ergosterol on the market have not been officially standardized. Indeed, ergosterol itself has not been standardized, so that the substance must be used with great care. Hess believes that regular tests of the calcium and phosphorus content of the blood should be made during the giving of the product as the one certain method of assuring normal rather than overaction of the beneficial ergosterol.

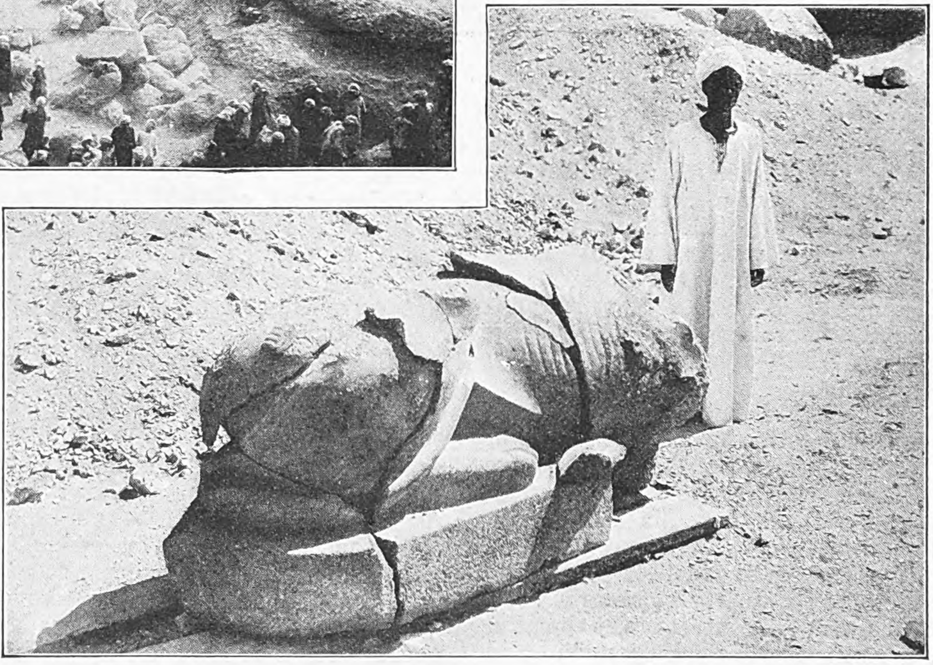


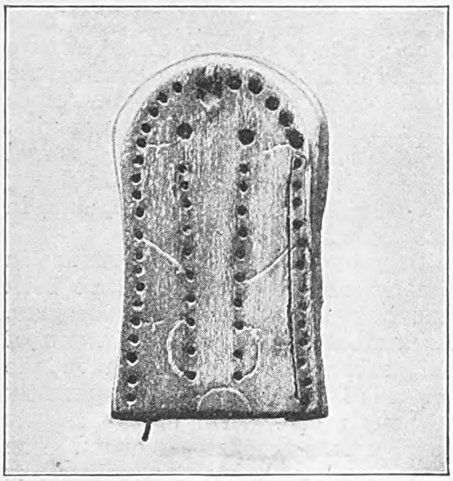
< CLEARING AN OLD QUARRY

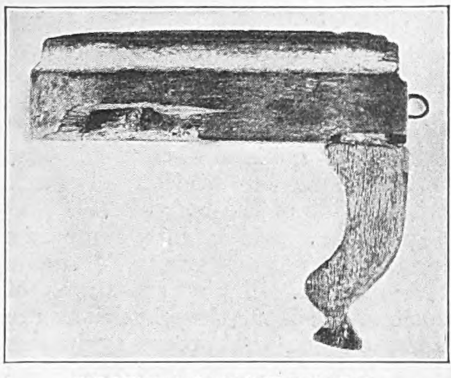
This view is typical of Egyptian archeological work. The chief objective was to salvage the statues from the adjoining temple which the ancient wrecking gangs had destroyed. Some fragments weighing a ton or more were recovered. Many of the statues were covered over so soon after they were carved that the elements had no effect on them and the colors of the paint were as brilliant as when first applied to certain places

∨ RE-ASSEMBLED GRANITE SPHINX

Several large granite sphinxes were found, probably from the temple courts. Here is one which has been assembled. They show how the Egyptian prized his hard stones and left their polished surfaces to be admired for their own sakes, picking out in paint only the details which need emphasizing, such as the headdress, the eyes, and the jewelry. The sphinx will take a worthy place in a museum after "repairs"





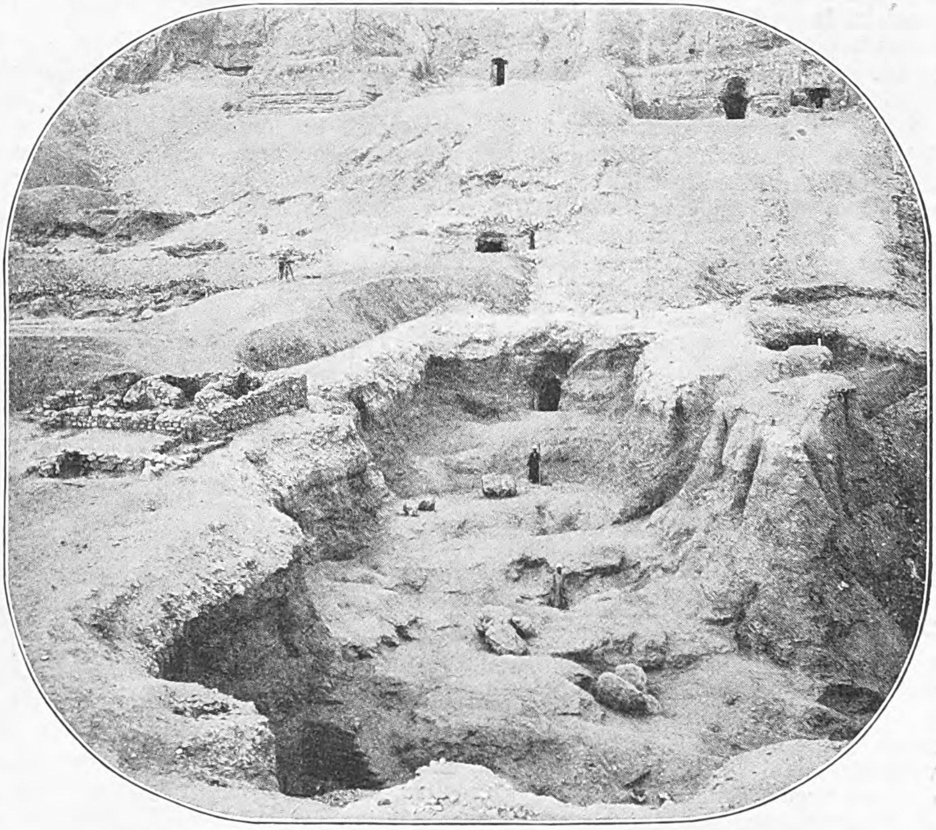


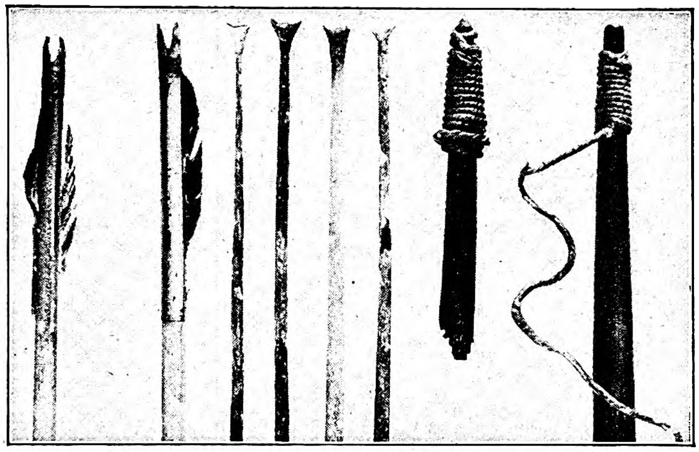
∧ EGYPTIAN GAME BOARD

With this game board we get an echo of one of the game crazes. It is the story of mah-jong 4000 years ago. This board is so worn that a patch had to be inserted to replace enlarged holes

AN ARCHITECT STAKES A CLAIM >

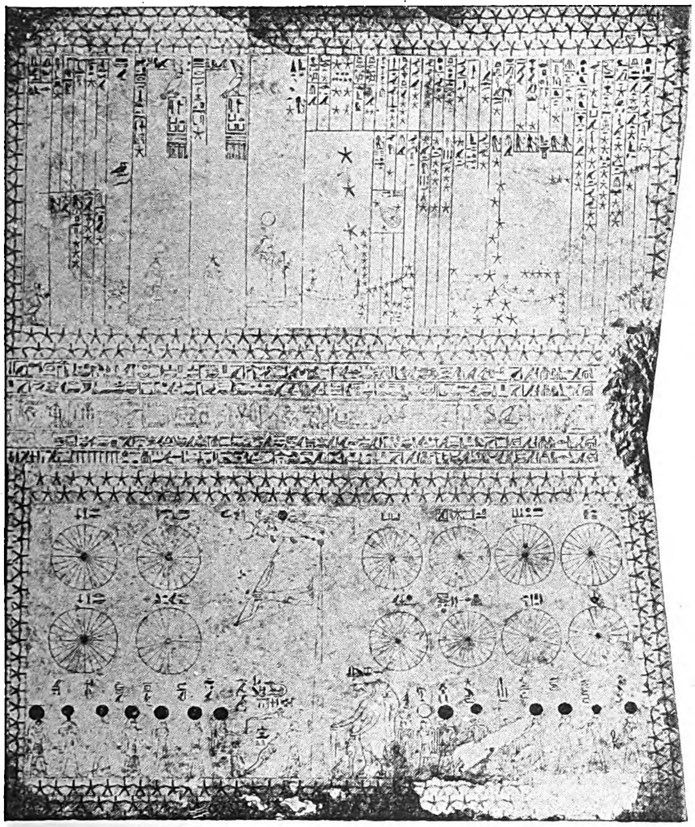
The "Superintendent of all the Royal Works," Senmut, the architect and engineer, had an aquiline nose, his face was expressive and wrinkled. Much of his life has been restored to us by the marvelous science of archeology. In this illustration, which shows the western end of the quarry, we find the brickwork at the entrance to Senmut's tomb at the lower left-hand corner. His intention was to have a perfectly conventional tomb and then a secret burial crypt under the temple. Our modern municipal contractors could take a lesson from this wily old engineer





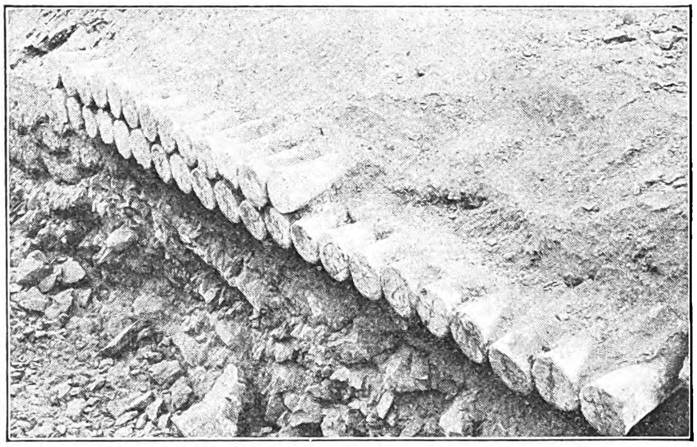
▲ THEBAN BOWS AND ARROWS

Chisel edges of flint were set in cement in an ebony tip, while the shaft was of reed with three feathers. They were extremely deadly. The nobles had enough bows and arrows in the crypts of their individual tombs to equip a bodyguard of their retainers



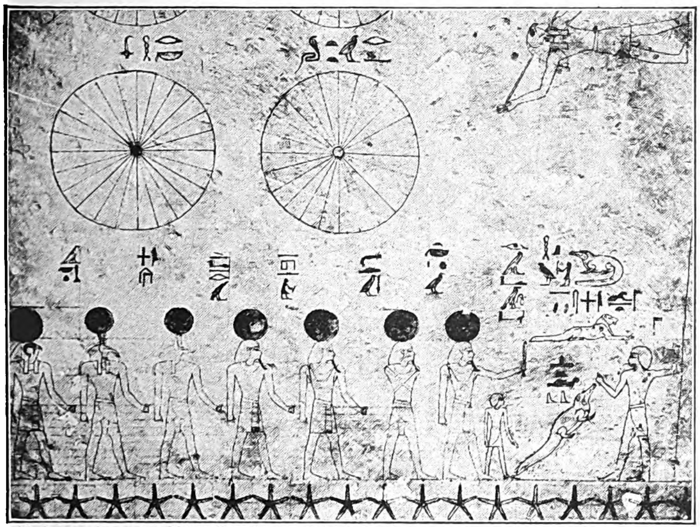
◄ AN ASTRONOMICAL CEILING

The gem of the decorated chamber in the tomb of Senmut is its ceiling. Here we have the heavens mapped out above us in one of the best and one of the earliest astronomical charts yet found, as drawn by an artistic penman or rather, brushman, of 1450 B. C.



▲ TERRA COTTA CONE FRIEZE

These cones probably represent the ends of the poles or logs of the roof of an ancient Egyptian house. Terra cotta cones a foot long are found on the Theban necropolis. Cones are 34 centuries old



◄ CELESTIAL BODIES DEPICTED

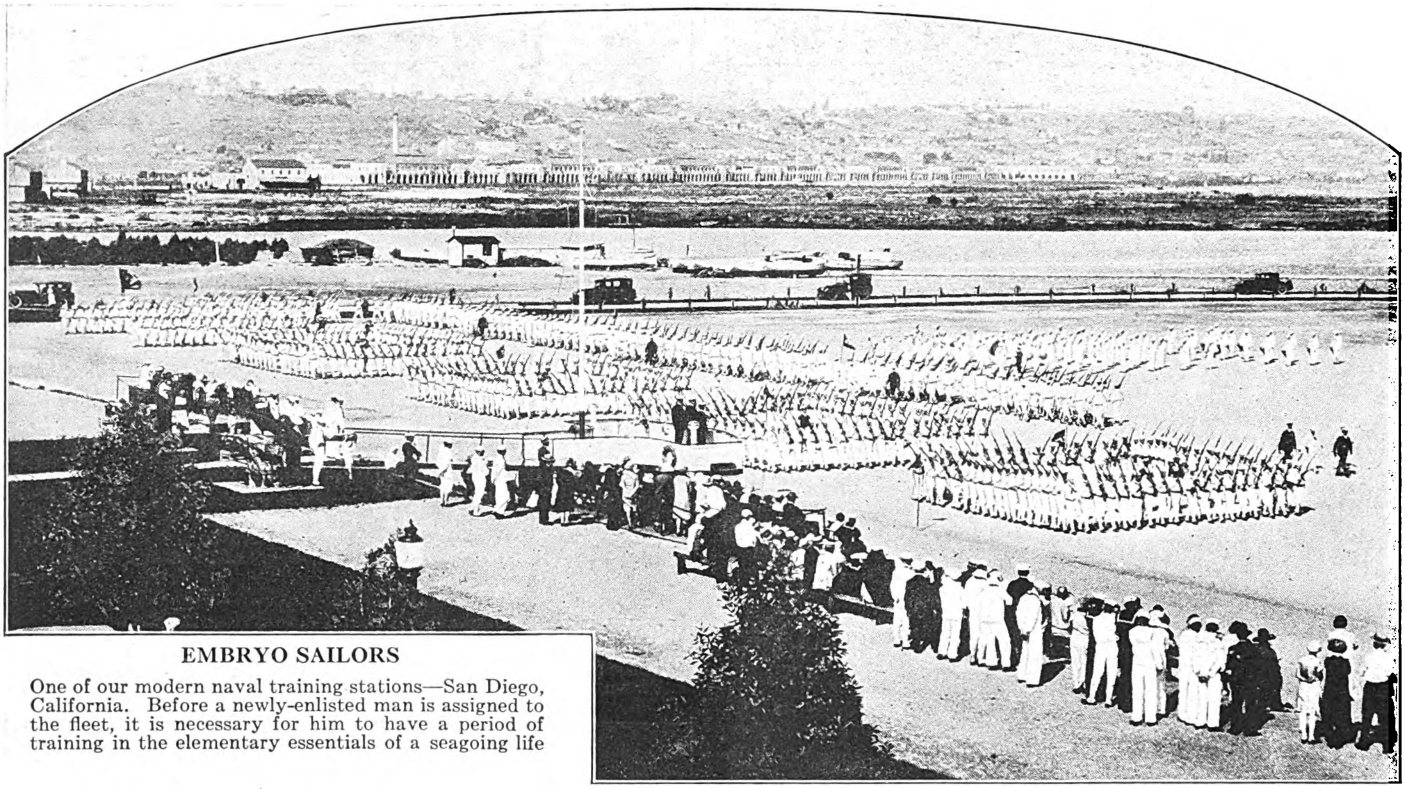
An enlarged view of the lower part of the upper picture. Across the sky are ancient monthly festivals each as a circle with its round of 24 hours and, below pass the constellations of the northern sky

All photographs courtesy Metropolitan Museum of Art

Adventurous Archeology

ONE of the best cross-sections of old Egyptian life which has ever been published will be found in the account of the Metropolitan Museum of Art's excavation at Thebes, 1925–1927, written by Mr. Herbert E. Winlock of the Egyptian Department. We only have space for one of the many stories in the interesting 75-page pamphlet. As our readers know, the Museum's archeologists have been carrying on excavations at Thebes for many years. The work is practically finished on the Temple of Mentuhotep and on the cemetery to the north, and most of the tombs have been cleared but the explorers had on their hands masses of fragments which once decorated them, and to fit these together was an Egyptian puzzle and not a Chinese one. From the bodies of soldiers remarkable information was obtained as to the nature of early Egyptian warfare. The work-tent took on some of the gruesomeness of a field dressing station — only the front was 4000 years away. The Theban bows and arrows were deadly, as were the stones from slings.

Most of the work centered around the Temple of Deir el Bahri. An important discovery of scarabs dispelled all doubts as to whether Hatshepsut founded the temple (1501–1479 B.C.). Her daughter married Thutmose III, and the mother-in-law kindly acted as regent and assumed the kingship and kept it after he reached majority. She was a prototype of Catherine of Russia and other female potentates. She built the temple to justify her assumption of the rule and depicted herself as a man. One of her chief supporters was an architect and engineer named Senmut and he gratified her desire for display. Alongside the entrance was a quarry from which stone was obtained for the construction of the temple and it was into this quarry that we find the statues and bas-reliefs glorifying the queen, thrown there after her irate son-in-law rose in rebellion at her usurpation. Senmut dug his own tomb and made it extend under the temple with a secret burial place which he never occupied, as he was probably done away with by the prototypes of the modern gunmen.



EMBRYO SAILORS

One of our modern naval training stations—San Diego, California. Before a newly-enlisted man is assigned to the fleet, it is necessary for him to have a period of training in the elementary essentials of a seagoing life

Naval Adequacy—V

Personnel Is a Primary Element of Naval Strength. In This, the Final Article of This Discussion, the Author Points Out Our Need for More Men

By CAPTAIN N. H. GOSS, U.S.N.

HAVING previously discussed naval bases and ships of the various types and classes with their relation to each other, we now come to the third primary element of naval strength—personnel. Regardless of ship strength, a navy depends on personnel, for a battle decision may rest on numbers and quality of men. After all, the men do the fighting, and a long line of records in history shows that good men in poor ships are better than poor men in good ships, unless outclassed in numbers.

Of the three principal naval powers that have been the basis of these discussions, Great Britain and Japan have an inherent advantage in the matter of personnel, because each is a homogeneous people and is and has been a sea-faring nation through centuries of tradition and practical experience. Each is through necessity a seafaring nation because it is dependent on sea communications for vital articles of food, raw materials, and the trade on which its prosperity depends.

The natural conditions in this country are considerably different. Our well-being and prosperity have come so naturally in the past through natural expansion and development of resources within our own borders that we have not felt the same necessity for development at sea. Our population, too, is heterogeneous and lacks the same community of interest as the others under discussion.

While, obviously, it takes time to build a ship, the fact that it also takes time to train personnel is not so generally recognized. The requisite time in our case is actually longer, too, because of the very fact that we are not an experienced sea-going people and hence our naval personnel, in addition to their specialized duties, have to learn also the rudimentary habits and customs of a life at sea.

IT is, of course, a matter of common knowledge that Great Britain possesses, incomparably, the greatest and most numerous merchant marine in existence; also that Japan possesses a very large and experienced merchant marine. This country, however, due to such various causes as general apathy, widespread prosperity, restrictive shipping laws, and lack of the same preference in favor of our merchant ships that our tariff policy has extended in the past to other industrial efforts, has failed to build up a merchant marine comparable in extent with the sea-borne trade of the country. Hence it lacks a great natural reserve of sea-going personnel such as that from which the British and Japanese are able to draw men and augment the strength of their specialized professional naval personnel.

This being the case, it might be expected that our practice would be to give greater permanence to the naval personnel which we do develop and train, but actually the reverse is true. While both the British and the Japanese have felt a sufficient need of permanence for their specialized naval ratings to make their normal period of enlistment 12 years, our enlistment term is normally four, and somewhat less for those enlisted for minority.

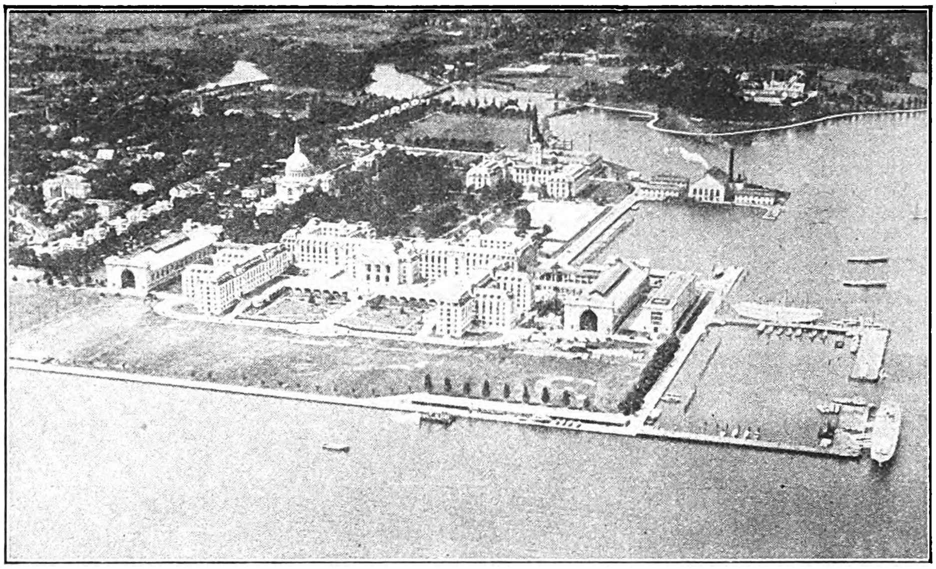
Thus it might naturally be expected that this country has a relatively larger naval personnel than that of the British and Japanese; but again the contrary is actually the case.

Other factors also enter into the naval personnel situation: this country is definitely committed to a purely defensive and non-aggressive foreign policy; it has never contemplated war as an instrument of aggressive policy; it has never looked forward to war as a means to an end but has always regarded war as a means of last resort; it has never considered entering it until all other means have been exhausted and war, alone, remained the only way of defending our rights. Hence there never has, nor will there ever be, any question of specially developing numbers of personnel with any definite conflict in view.

NEVERTHELESS, to a country whose commercial interests are as far-flung as ours and whose sea trade reaches all quarters of the globe and is, in fact, the greatest in volume in the world, the navy must be, and is, the first line of defense. But the navy will not be equal to the task of preventing encroachments upon our rights or of defending our interests, unless its personnel is adequate.

Past experience has shown that conditions leading towards war develop quickly, so that in a national emergency there would not be time to train additional naval personnel. History records that actual attacks have occurred even before the formal outbreak of war, that short notice ultimatums have been served which left no time even for mobilization, so that an opportunity to prepare especially for an emergency is not to be expected and cannot be counted upon by those responsible to the country for its naval defense.

Our experience in the World War had, in some ways, a misleading result since, during that conflict, we were able to prepare ships and train large numbers of naval personnel after the declaration of war. The reason for this was that the German fleet was already blockaded by the Allied navies. The important lesson to be learned from this is that we were actually so weak in personnel that it was necessary to devote our entire battle fleet to the sole purpose of training men. We were so deficient in trained personnel that it was necessary to detach officers and men from our first line battle-ships in order to furnish the armed guards supplied to our own merchant vessels.



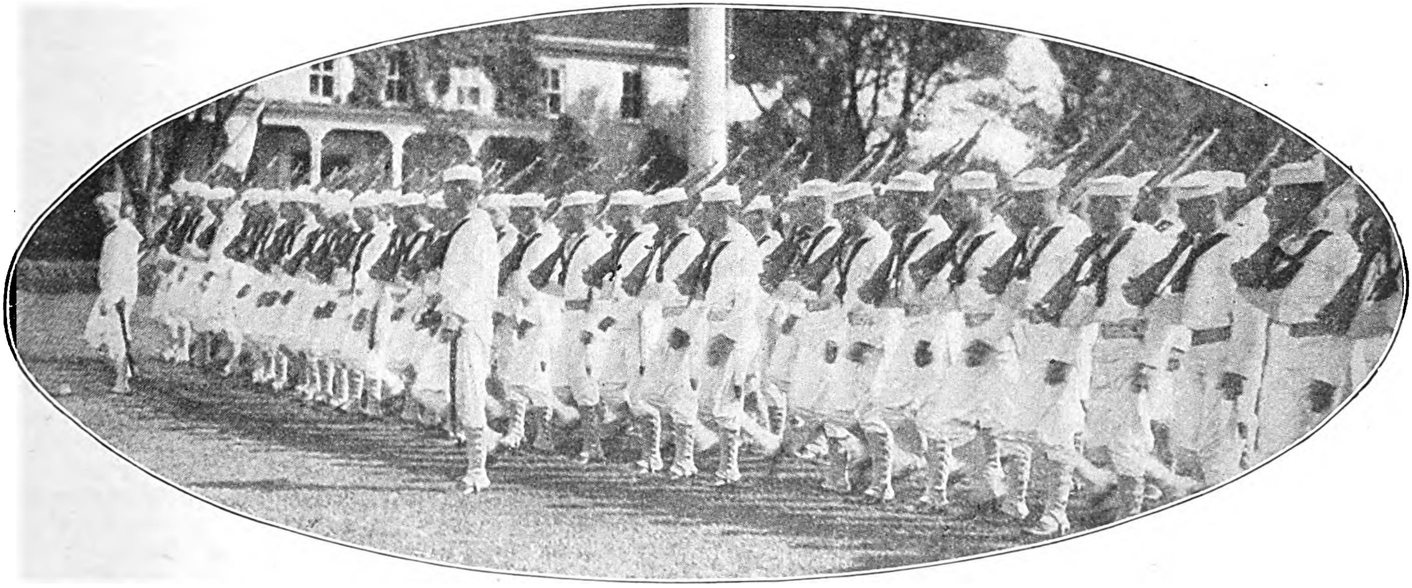
WHERE OFFICERS ARE MADE

The United States Naval Academy at Annapolis, Maryland. At this institution, which may justly be called the University of the Navy, men are given thorough training for naval leadership

Naturally the high quality of personnel available in time of war learned the rudiments more quickly under these conditions, but it is surely not to be expected that in a future emergency we will have an allied fleet holding the enemy at bay until we can train new personnel to fill out our deficiencies; and no personnel material, however high in quality, can be effective unless adequately trained.

Since we are not a sea-faring people, our naval personnel has to be trained in everything, beginning with the rudiments of life aboard ship. Newly-enlisted recruits are first sent for a few months to one of the naval training stations, of which we have three—at Newport, Hampton Roads, and San Diego—in active commission, with one at Great Lakes, near Chicago, in reserve.

TO learn the elementary essentials of a sea-going life requires not less than six months, and although the newly-enlisted recruit arrives aboard ship in less time than that, it is that long before he begins to be an asset. To make him a valuable and dependable man-o'-war's man requires not less than two years. Therefore, about half of the normal enlistment period of four years is consumed before a first-enlistment man is of any great value. To make petty officers, as the ratings corresponding to non-commissioned army officers are known at sea, requires con-



THE SAILORS' LAND TRAINING

The Naval Training Station at Newport, Rhode Island. Three of these stations are in active service and one in reserve. This early land training usually requires several months for a newly-enlisted man but it takes about two years to make a dependable man-o'-war's man of him

TYPE	United States			Great Britain			Japan		
	*No. V.	L. O.	E. M.	No. V.	L. O.	E. M.	No. V.	L. O.	E. M.
Capital Ships	18	918	21,776	20	1,036	24,998	10	526	12,800
Light Cruisers	18	416	8,626	62	1,236	26,954	29	551	12,058
Old Cruisers	22	352	9,900	9	135	3,150	15	345	10,300
Mine Layers	4	30	1,164	0	30	1,164	0	18	699
Destroyer Leaders	0	0	0	18	180	2,700	24	240	3,600
Destroyers	276	1,932	30,360	164	1,148	18,040	83	581	9,130
Old Destroyers	33	165	2,310	6	30	420	12	60	840
Fleet Submarines	9	54	711	20	120	1,580	26	156	2,055
Submarines	50	200	1,950	29	116	1,131	45	180	1,755
Old Submarines	27	81	783	23	69	667	10	30	290
Tenders and Repair Vessels	21	159	5,098	21	159	5,098	13	95	3,050
Staff duties afloat		180	1,103		180	1,103		108	661
Other Auxiliaries	53	205	5,415	53	205	5,415	31	123	3,249
Total	531	4,692	89,196	425	4,644	92,420	298	3,013	60,487

*No. V.—Number of Vessels. L. O.—Line Officers. E. M.—Enlisted Men.

TABLE 1

siderably longer—from four to six years normally and in some cases, longer.

The navy today is composed almost completely of specialists. More than 40 specialties are employed aboard ship, each of which does work of a highly technical character requiring special training and experience. Many of these specialties are found only aboard ship and require the services of gun pointers, range-finder men, fire-control men, gyro-electricians, radio direction-finder men, quartermasters, torpedo men, signal men, and the various engine and fire-room specialists necessary to operate the delicate and high-speed steam, electric, and internal combustion machinery.

SINCE weights and space must be limited in a ship, boilers must be of the high-pressure type and the turbines high speed. As an example of power generated and controlled in a modern vessel, our modern cruisers develop about 100,000 horsepower; our new plane carriers develop 180,000 horsepower—more power in the hull of a single vessel than is utilized in any except perhaps the half dozen larger cities in the country; and even a destroyer, within the confines of its small hull, develops 28,000 horsepower. All this is in addition to the machinery for operating turrets, guns, and for controlling gun fire. Since this machinery is found only aboard ship, all personnel to operate it must be trained by the navy itself since no outside training would be properly specialized.

To assist in training for these special ratings, the navy operates service training schools on shore at the various training stations and at some of its specialized industrial plants, but training men for these duties obviously requires time, and this, plus the necessity for actual experience aboard ship, is the reason why a modern sailor—really a trained specialist—cannot be made overnight. With our system of short enlistment this process has to be repeated over and over again as men come and go. This is not entirely without value, however, since men discharged back into civil life do constitute some reserve of experienced sea-going men.

IN time of war, the personnel of the navy naturally has to be greatly expanded in order to take care of large numbers of auxiliary vessels, fuel, store, and supply ships, tugs, mine sweepers, et cetera, necessary to maintain the fleet, and on which this country, because of its lack of well-located naval bases, must depend.

The first problem then is to obtain a nucleus of the necessary officers to control these additional vessels. Many of these are drawn from the more experienced, higher ratings of the enlisted personnel who, because of their experience, have the necessary qualities to make valuable officer material for the lower grades. But this very thing operates as a handicap in assimilating and training large numbers of newly-enlisted men since it is these same petty officers that are of the most value in training new recruits.

The problem then of training these large numbers of men, however great may be their potential value due to the high quality of our material, is a large one as indicated by the fact that, in the World War, our navy expanded to a force of more than 500,000 enlisted men.

The natural source of officer material is the Naval Academy at Annapolis. After four years of scholastic training there, augmented by practical drills and exercises and three summer cruises aboard regular vessels of the fleet, midshipmen are graduated into the commissioned service. Their development into valuable officers, however, has then only begun and it requires a number of years more before they are sufficiently experienced to be entrusted with responsible positions.

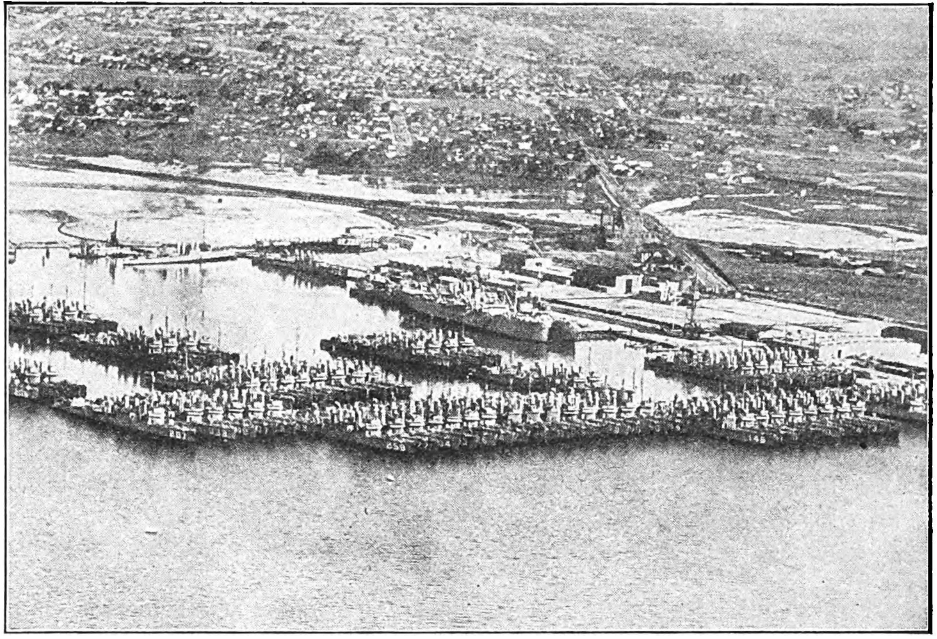
OFFICERS, too, are trained in some of the more important naval specialties such as engineering of various kinds, radio, electrical propulsion, internal combustion engines and also, for example, in ordnance, fire control, and torpedoes. Thus we see how the process of training goes on for a number of years after the midshipmen leave Annapolis, in order to develop a selected corps of highly trained specialists on which the navy may depend for improvements in design of vessels and their equipment. Later, too, selected numbers from the higher grades are trained for the duties of higher command at the Naval War College.

We have previously discussed the various types of vessels and the classes and numbers of each type which compose the fleet. It might, perhaps, be assumed that the personnel strength of the navy in officers and men is sufficient for at least the normal peace time complements of these vessels, but such is not the case, as will be shown. If the navy possessed suffi-

IN A FOREIGN LAND

Maintaining our rights abroad. An American landing force of sailors in Shanghai, during a Chinese civil war cient personnel to man its existing combatant vessels, its problem on the outbreak of war would be comparatively simple since it would then only need to man the necessary auxiliaries required to support the fleet.

Actually, however, many of our men-of-war are laid up, out of commission, due to lack of personnel with which to man them, and at the outbreak or near approach of war, our Navy Department would be faced with the problem of manning not only the great numbers of auxiliary vessels required but also an immense number of fighting vessels. The accompanying tables and the discussion which follows include numbers of line officers and enlisted men required to man the authorized vessels of the existing fleet with a normal or peace-time complement only. They do not include the augmented numbers that would be required in war-time for additional watch and other duties.



WITHOUT PERSONNEL TO MAN THEM

Our only potential reserve, surplus destroyers, helplessly immobilized at San Diego, California, because we have insufficient men. Other destroyers are immobilized at Philadelphia

FOR purposes of comparison with our own, the numbers required to man the existing authorized British and Japanese fleets are also included in Table 1, using the same standards of personnel for the various types and classes used for our own vessels.

In this tabulation, certain selected auxiliaries have been included with our fleet. More important among these are the tenders for destroyers and submarines, and repair vessels. Without these, our destroyers, submarines, and light craft such as fleet tugs and mine sweepers could not operate away from their home yards which, as we have seen in previous discussions, are not located with reference to our probable theaters of war operations. The only other auxiliaries included are the few supply vessels, transports, oil tankers, fleet tugs, and mine sweepers actually in commission in peace-time, the personnel of which could only supply a very small nucleus of the supply and transportation force necessary in war.

	United States		*Great Britain*		*Japan*	
	*L. O.	E. M.	L. O.	E. M.	L. O.	E. M.
Fleet, including Air Force	5,556	97,794	5,508	101,108	3,350	65,645
Shore Establishment	1,786	16,658	1,786	16,658	1,071	9,995
Under Training	243	7,004	243	7,004	145	4,203
Grand Total	7,585	121,456	7,537	124,680	4,746	79,843

*L. O.—Line Officers. E. M.—Enlisted Men.

TABLE 2

For strict purposes of comparison, the same relative allowance has been made for the British fleet and the same, in proportion, for the Japanese, although actually, due to their interior lines and abundant bases, they do not have needs similar to ours. Table 1 shows the total number of officers and men required by the three nations to man the existing authorized fleets and to provide a small nucleus for auxiliaries.

The total shown for the United States does not include aircraft or the personnel necessary to man our plane carriers, aircraft tenders, and naval air stations on shore. To man these and the equipment being built under the so-called Five-year Naval Aircraft Program, now well advanced towards completion, requires roughly 1,000 officers and 10,000 men.

The actual figures under the present operating plan but not including personnel manning planes aboard our battle-ships and cruisers which were included with their regular complements, are 864 officers and 8598 men. For purposes of comparison, the same numbers relatively are used for the British and Japanese fleets, although the British with their separate air service do not use strictly naval personnel for this purpose.

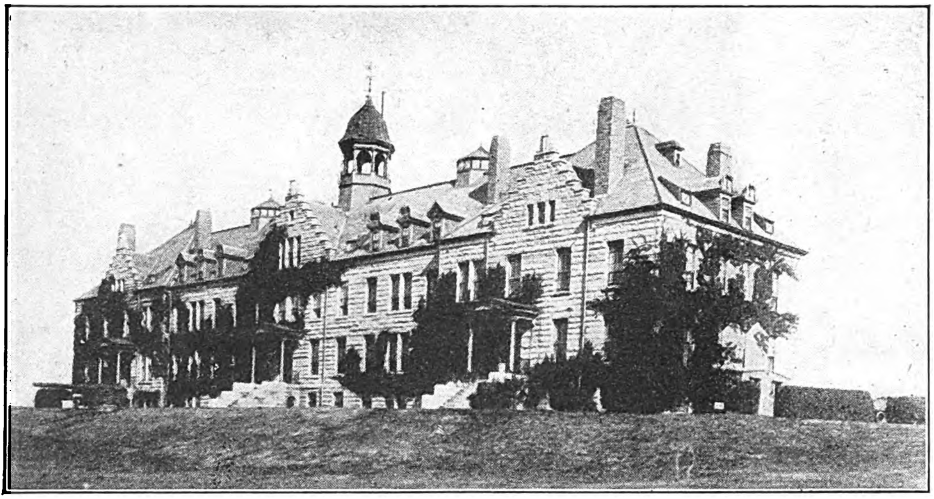
To support and maintain a fleet at sea, a shore establishment of the navy is necessary. This includes naturally the officers on duty in the Navy Department, at the navy yards, at the Naval Academy, and the officers and men at the various naval operating and supply bases on shore, submarine bases, fuel and ammunition depots, at the naval radio stations, on other essential communication duties, at the naval training stations and service schools, the staff and students at the Naval War College, and officers under other post graduate instruction; all attending to the thousand-and-one details on shore necessary to supply, equip, and maintain the fleet at sea.

Experience has shown that about 20 percent of the total of enlisted personnel is required for these duties. Actually, with every shore activity cut to the bone in order to maintain in commission as many vessels of the fleet as possible, this ratio has been reduced in peace time to about 18.5 percent.

AT present, the number of officers and men assigned to shore duty are 1786 and 16,658 respectively. An additional 243 officers are under training and specialized instruction at the Naval War College and in other post-graduate courses; while 7004 enlisted men are at the naval training stations and at various schools for specialist ratings.

Combining these figures we find, in Table 2, the number of line officers and enlisted men required for the normal complements for the authorized vessels of the fleet with only minimum peace-time shore activities.

These figures do not include some of the normal naval peace time activities afloat such as the smaller patrol vessels employed in the Caribbean and Central American region, the river gun-boats stationed in Chinese waters, or vessels engaged in hydrographic surveys for the purpose of



WHERE OFFICERS ARE TRAINED FOR HIGHER COMMAND

The Naval War College at Newport, Rhode Island. Each year, selected groups of naval officers are sent to this institution where they are trained for the duties of higher command

making new charts. The officers and crews for these are taken from the complements of some of the combatant vessels now laid up out of commission. It may be emphasized again, also, that the small numbers assigned to auxiliaries are only a very small proportion of the number that would be required for this service in war. Actually, more than the number shown would be required for additional tenders and repair vessels alone and without which our destroyers and submarines, now out of commission, could not operate in any principal theater of war.

HAVING detailed the numbers required to man the existing navies, it is interesting now to turn to the regular naval personnel actually available to each country which is:

	United States	Great Britain	Japan
Line Officers	5449	4285	5281
Enlisted Men	84,410	92,646	72,681

These numbers, too, are somewhat misleading since the British actually have a separate air force and have a special permanent shore organization which takes the place of much of the naval personnel which we employ on shore. So actually we find that the British and Japanese are fortunate in having quite a larger proportion of both officers and men.

Having investigated the regular naval personnel situation we may next consider what naval reserves each power under consideration has available to draw upon for manning ships now laid up, and as a nucleus for manning the immense numbers of auxiliary vessels required to maintain its fleet in war.

Present naval reserves are approximately as follows:

	United States	Great Britain	Japan
Officers	5414	10,951	3464
Enlisted Men	26,425	64,897	40,388

These reserves are of much value but this country is relatively much weaker in effective naval reserves than the British or Japanese since they have also an enormous reserve of trained sea-going personnel in their merchant fleets to draw upon, while in this country we have not sufficient merchant marine to man the hundreds of merchant vessels laid up already.

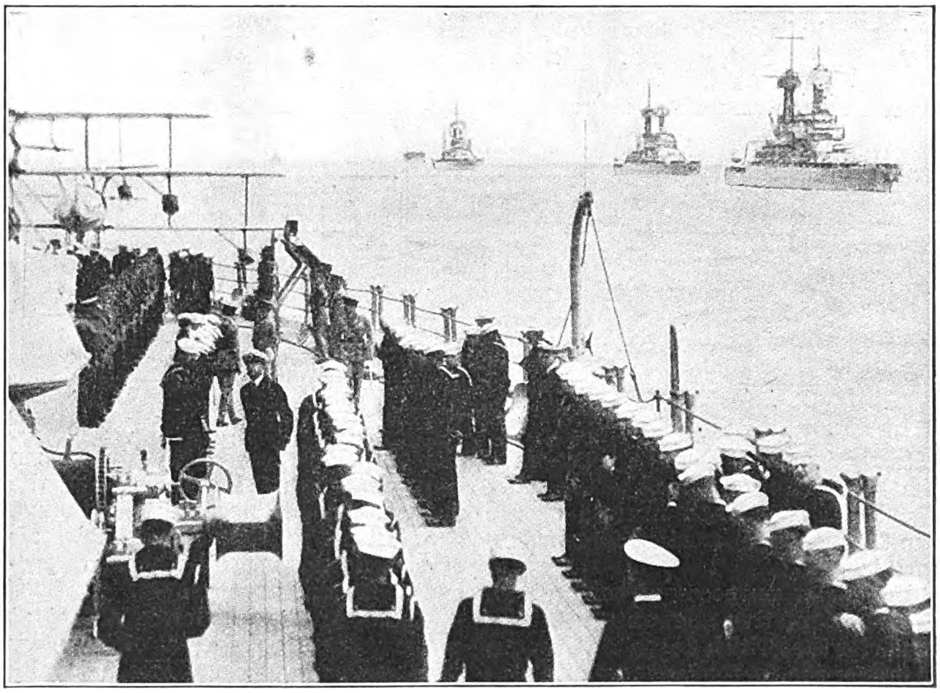
Our authorized enlisted personnel are easily kept up to strength but officers, due to decreased output of the Naval Academy and peace time resignations, number only about 5300. The last congress authorized an increase in the number of midshipmen of approximately 20 percent but these will be required primarily to care for increased aviation demands so that few additional men will be available to man sea-going vessels.

We believe we have no reason to fear comparison of the quality of our naval personnel nor of our naval vessels but if, as at present, we have comparatively less trained personnel to man the ships we already possess, we cannot but suffer in comparison of actual naval strength with the British and also with the Japanese since their fleets are comparatively so much more fully manned and since their positions so near to our detached possessions, coupled with their abundant and well located naval bases, confer on them such great natural advantages.

LONG ago the British learned the value of trained personnel. Since the days of their French wars when their more efficient personnel, trained under St. Vincent, was able, under Nelson, to overcome the individually superior vessels of the French, they have seen to it that their fleet did not lack sufficient numbers of efficient personnel. The Japanese learned the same lesson under Togo in the Russian war when their superior personnel was able to overcome superior numbers.

They have learned by experience the lesson which is apparent to those in this country who are interested enough to look for it: which is that a vessel laid up, out of commission, of however great potential value, has no present actual military value. Since this non-aggressive country will never make special preparation with any definite conflict in view, the only safe way seems to be to train and maintain in peace time sufficient personnel strength to make our fleet in commission strong enough to be an effective insurance against war and a dependable first line of defense in event of war.

THE END

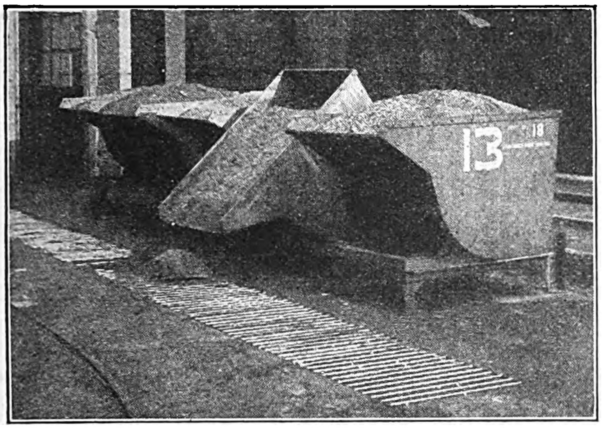


THE TRAINING CONTINUES AT SEA

After the naval recruit has received land training and is assigned to a ship, his training becomes more intense and specialized. The illustration shows an inspection aboard a battleship

Saving The Scraps

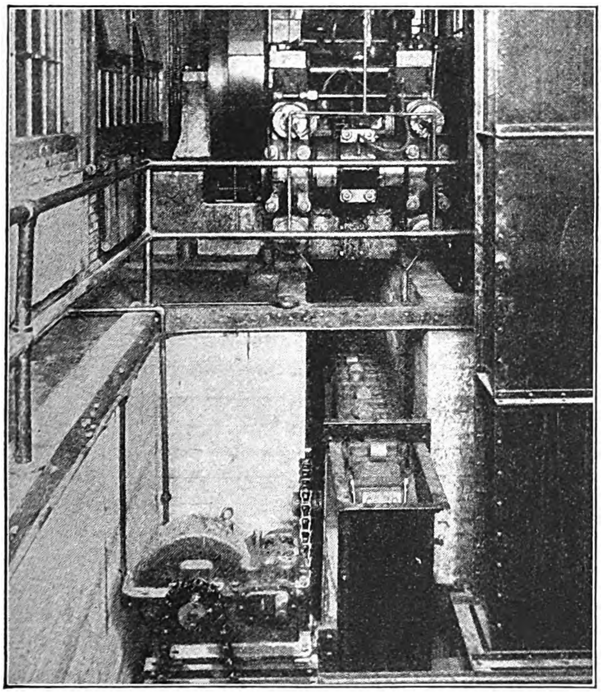
Cast-Iron Chips and Borings Briquetted For More Efficient Re-melting



DELIVERING THE TURNINGS

One-ton hopper dump cars deliver cast iron turnings and chips to a floor grid over a horizontal conveyor

IN the production of automobile and other engines, agricultural implements, machine tools, and almost any machinery, a certain amount of the iron is cut away from castings to leave finished surfaces and establish accurate dimensions, just as wood is wasted when the trunk of a tree is cut into usable sizes of boards or timbers and when the lumber is planed or cut for building construction or furniture making.



THE CONVEYOR SYSTEM

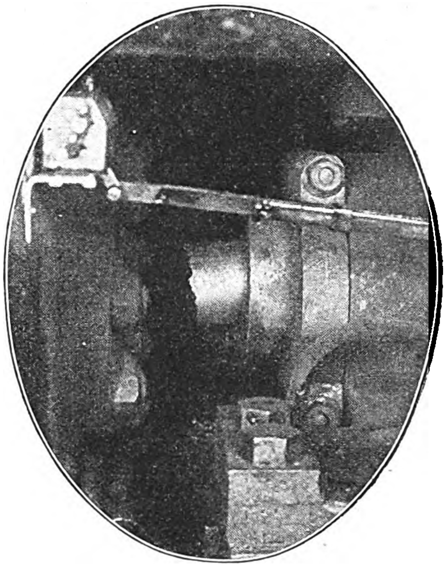
Horizontal and vertical conveyors transfer briquettes to bins on cupola charging deck

In iron-using industries, it has been common practice to collect the cast-iron chips or borings and sell them as scrap. According to present market quotations such cast iron and semi-steel borings are worth about nine dollars per ton at Gary or Pittsburgh or other steel making centers.

It is because attempts to re-melt cast iron and semi-steel borings in the ordinary foundry cupola have been so unsuccessful that common practice has been to sell them as scrap. A few foundries have experimented with enclosing the borings in metal containers. But when the containers melt under the intense heat of the cupola, there is a heavy loss through burning of the finely powdered iron or blowing out through the stack under the forced draft.

In the foundry of Dodge Brothers, Inc., such borings are now being compressed into briquettes, in which form they can be re-melted with no more loss than with new foundry iron. A pressure of over 300 tons is exerted in forming a briquette four inches in diameter and three and one half inches long. The volume of the finished "iron biscuit" is less than one-third the volume occupied by the loose borings and the briquette weighs about 8 pounds, or from 75 to 85 percent as much as a piece of solid cast iron of the same dimensions. Under the intense pressure exerted, the borings, without any binder, stick so firmly together that the briquette is about as resistant to shock as an ordinary building brick.

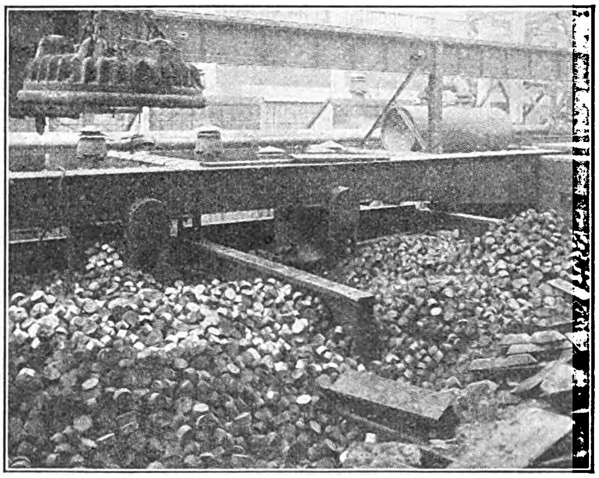
The facts that a rough casting for the cylinder block of an average six cylinder car weighs about 200 pounds and the finished block weighs about 150 pounds and that a rough flywheel casting weighs 70 pounds and, when finished, 50 pounds, indicate the amount of loss which takes place in ordinary practice and the amount which can be saved by the new process. The machine, the only one in America used for briquetting cast-iron borings, it is stated, has a capacity of 50 tons of briquettes per day and the entire cost of operation is only about two dollars per ton. It is pointed out that the character of the product of the foundry is benefited by the re-melting of this material which, before being previously poured into castings, was known to conform to the chemical specifications prescribed by the foundry chemists.



OUT COMES A BRIQUETTE

A briquette, made without binder under a pressure of 300 tons, leaving machine

On this page, some of the elaborate equipment for making and handling the briquettes is shown. The photograph at the bottom of the page is particularly striking because it shows the convenient size of the briquettes, *en masse*, and one of huge overhead electro-magnets which handle them as easily as if they were ordinary solid pieces of scrap iron.

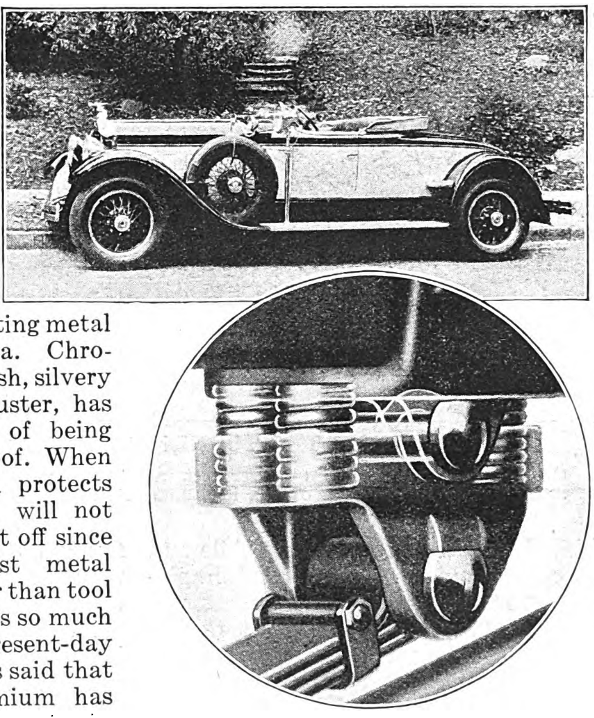


READY FOR RE-MELTING

Briquettes issue from the conveyors—left center—to this dump where they are handled by electro-magnets

Your Next Automobile

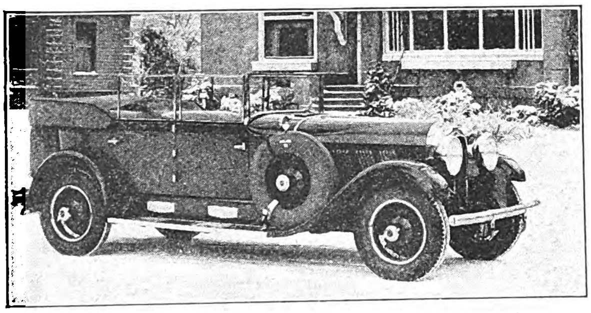
Few Mechanical Improvements But a Wide Variety of Body Designs and Colors Are Features for 1929



PACKARD

The attractive Packard eight roadster, the body of which is custom-built by Rollston. Below is a phantom view of the trunnion spring bracket for damping vibration

ADVANCE information about the 1929 models of American automobiles indicates that they will be but little different in any respect from those we see on the streets every day. Most manufacturers apparently have felt that there is little room for improvement of mechanical features and have concentrated their attention on exterior design and finish. Some cars have changed radically in appearance in an attempt to appeal to the esthetic sense of the purchaser—or his desire for variety, as you will—while some have excused themselves for their lack of new models by the argument that they thus protect owners against obsolescence of present models.



AUBURN CONVERTIBLE FIVE-PASSENGER

With top, side glass, and columns down, this model is a regular open car. When all are up, it is a sedan

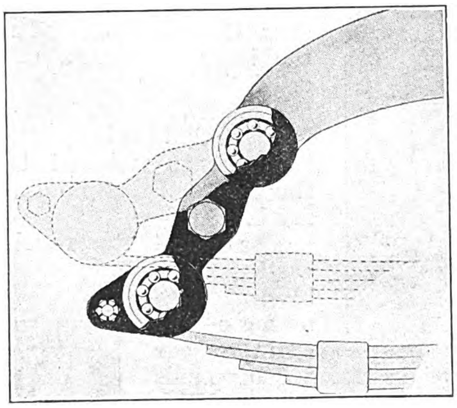
The lines of the new cars vary between wide extremes. In general, an attractive yet conservative mean has been attained but some cars show a greater tendency than heretofore toward long, streamline effects which give the impression of trim fleetness; and quite the reverse, one is built with what have been called "voluptuous" curves. There will be a greater choice of colors this year than ever before.

THIS will be welcomed by the many who, noting the tendency toward gayer colors in almost every article in common use, have wondered why most cars were available only in somber, neutral finishes. Louvers are horizontal on many of the new models. Monograms of several have been changed; on one or two they have changed position; and one in the higher price range which has never used a nameplate has created a crest for the radiator shell.

It will be noted particularly that chromium has been adopted by a great many manufacturers as a plating metal for radiators, trim, et cetera. Chromium plate, which has a grayish, silvery sheen and extremely high luster, has the advantages over nickel of being rust-proof and corrosion proof. When properly applied, chromium protects the base metal indefinitely, will not peel, nor will abrasion wear it off since it is the hardest metal known: it is harder than tool steel. Since there is so much plated trim on present-day cars, however, it is said that the use of chromium has been the cause of the narrowing down of the radiator shells so noticeable in the new models; the high luster had to be subdued in some way.

So far as we have been able to learn in our survey, few radical improvements in vital parts have been effected, although some are worth noting here. Automobile engineers nowadays seem more interested in refinements in the design of parts affecting the riding qualities, vibration, et cetera. Some of these features will be discussed, together with descriptions of the more striking body designs.

Perhaps the most outstanding development for improving riding quality is the Packard trunnion spring bracket assembly which prevents steering wheel kick and shimmy. This condition, prevalent since the advent of the balloon tire which, because of its resiliency, absorbs shocks even from the smoothest pavements and sets up a synchronized vibration known as front wheel shimmy, has occupied the attention of the entire motor industry for years. Packard engineers, while studying the problem, drove a foreign car which could not be made to vibrate in this fashion.

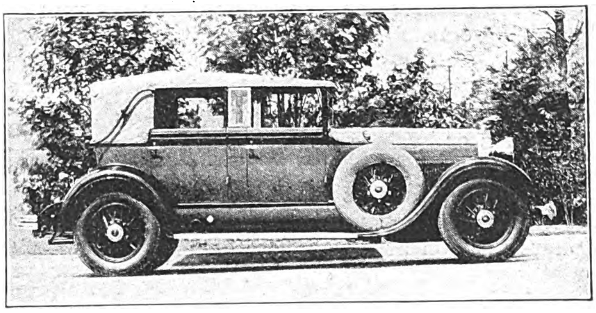


STUDEBAKER SHACKLE

A side view of one of the new ball-bearing shackles now standard on Studebakers

THEY discovered that the bracket fastening the rear end of the left front spring to the frame had become loosened. When this was tightened, the car immediately shimmied. With the bracket loosened again, the car again refused to shimmy. Thus after further study, the Packard device was evolved—the result of an accidental discovery. It consists of a bracket containing four heavy steel springs which allow just enough movement of the left front spring to dampen out the road shocks transmitted through the balloon tires to the front wheels.

Final results were obtained through the combination of the new spring bracket, the original Packard idea of

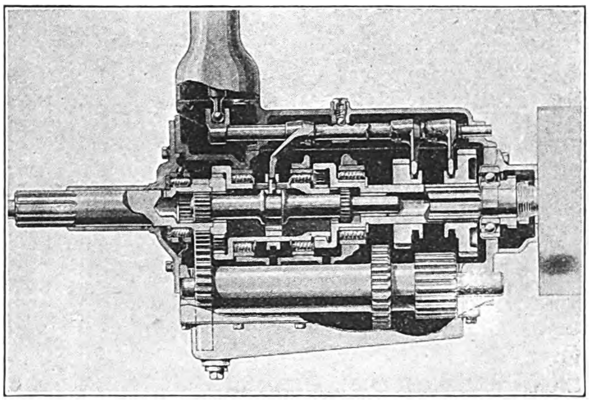


LINCOLN CONVERTIBLE SEDAN

A smart double-purpose car which reflects the distinctiveness of the Lincoln cars. Body is custom-built placing the shackles at the front end of springs, the under-slung front axle, and the new Packard hydraulic shock absorbers. With road shocks eliminated from the steering mechanism, Packard was able to put ball bearings on each side of the steering sector, thus making what has been declared to be effortless steering regardless of the speed.

Packard officials state that no new models other than those announced last fall, will be exhibited at the New York Automobile Show in January, 1929.

Studebaker will introduce no innovations at the show, but the first cars equipped with the new ball-bearing spring shackle—which is exclusive with Studebaker and has been adopted as standard for all models—will be shown. Developed by engineers of the company, this shackle has been tested for a year in the laboratory and over nearly 200,000 miles of road. The manufacturer claims that no lubricant except the original grease was used during the entire test and that, at the end of the tests, the shackles showed no wear.



GRAHAM-PAIGE FOUR-SPEED GEAR BOX

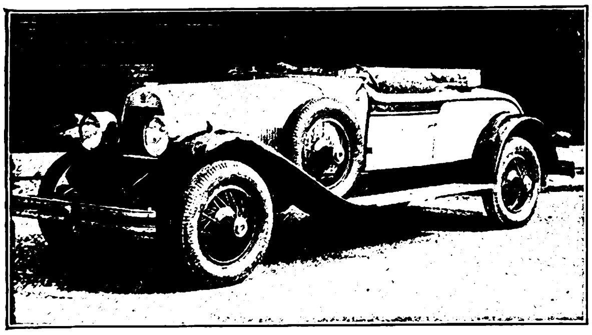
New four-speed transmission makes possible high road speeds at low engine speed and improves performance

THUS with these, Studebaker engineers claim that the necessity for frequent lubrication, wear, and noise has been eliminated.

A distinctly new body design, hitherto unobtainable except on special order from custom coach builders, has been brought out by Auburn. This is the phaeton convertible sedan. It is a full five-passenger model with a special collapsible top that can be put down readily to convert it into a touring car. The windshield pillars and center pillars are unusually narrow and can be removed when the top is down and the glass sides are down. When the top is up, this car is a regular five-passenger sedan.

Duesenberg, Incorporated, a subsidiary of Auburn, exhibited early in December, new models in the higher price class designed by Fred S. Duesenberg, famous racing car builder. A 265 horsepower motor of the straight-eight type powers these new cars, a standard open model of which has been driven 116 miles an hour, and 89 miles an hour in second speed.

Many features of the Duesenberg are entirely new to car owners. For example, it has an altimeter which not only serves to indicate the altitude of the country through which the car is traveling but also acts as a barometer. More important is the automatic lubricating system and the series of lights which indicate the action of the system. Every point of the chassis is automatically lubricated from a central point. Oil is forced into chassis bearings after every 80 miles, a green light flashing when the operation has been successfully completed. If the operation takes place but no oil is forced into bearings due to lack of supply, a red light flashes. Outstanding features of the cars are their power, long sweeping lines, and harmonious design. One other point worth noting is that, besides the radiator and trim, almost every chassis part except the frame and the axles is chromium plated, even to the exhaust manifold.

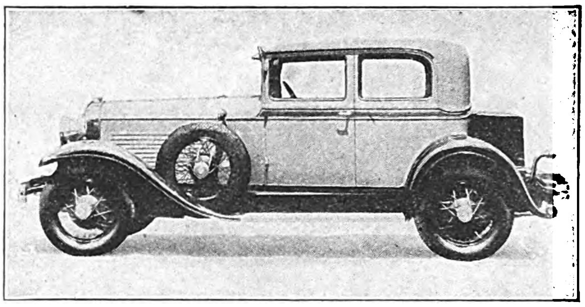


DUPONT ROADSTER

Beauty of line as well as comfort mark this smart new model which is one of the new eight-cylinder duPonts

Another car that was on exhibition early in December is the Lincoln Aero Phaeton, designed by LeBaron. In this may be seen the first automobile with a true airplane motif. Its long wheelbase, horizontal louvers, low-swung chassis, sweeping fenders, plated disk wheels, seats following the lines of airplane cockpits, and a rudder-like projection in the rear, show the appropriateness of the designation "Aero." With the exception of this model, the Lincoln Motor Company will announce no fundamental alterations in 1929.

The Marmon Motor Car Company announces a new series of its two lines of straight-eight cars, the new series Marmon "68" and "78." Many mechanical refinements have been made in these models, including a vibration-absorbing clutch in the "78," insulated manifold, more expensive bearing construction, and refinements in spring suspension.

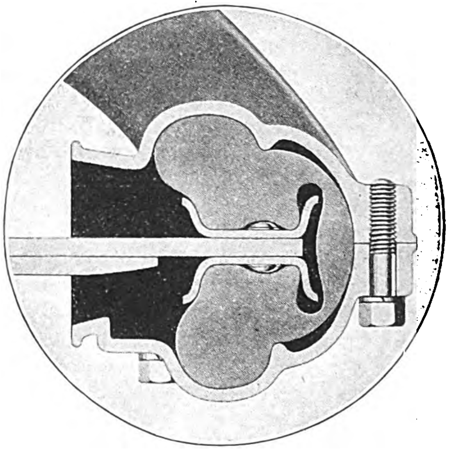


MARMON "78" VICTORIA

The graceful lines of this four-passenger Victoria are quickly apparent. It embodies many improvements

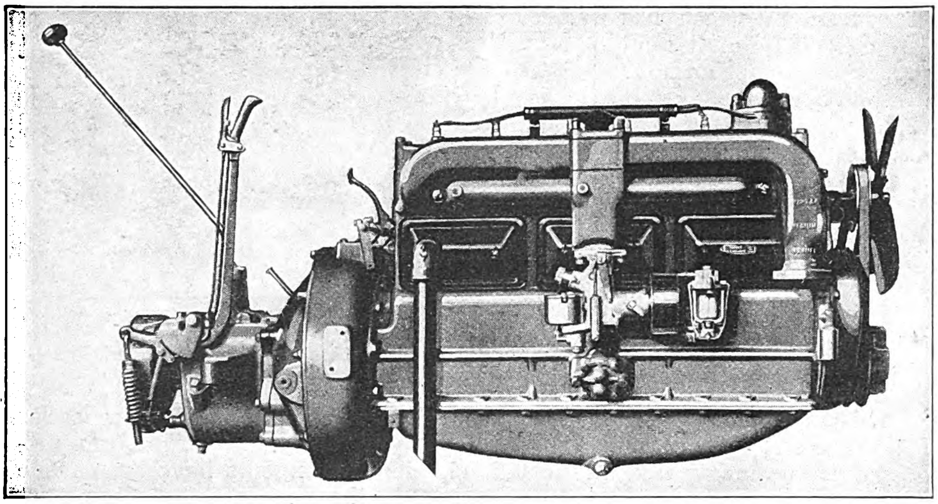
THE vibration-absorbing clutch plate, exclusively on the Marmon "78," eliminates the vibrations that tend to shatter the gears and, in addition, gives a damping action that cuts vibration in the driving line. This result is effected by the use of high grade rubber inserted between the driving hub and plate.

Graham-Paige Motors Corporation claims it has something of interest to exhibit at the Automobile Show. Permission to publish descriptions prior to the show, however, was refused. But the four-speed transmission, developed for use on the three series of six-cylinder cars as well as on the eight, illustrated herewith, is noteworthy. The manufacturers say that their new high-geared rear axle insures low engine speed at high road speeds, the quiet, internal-gear third speed providing excellent acceleration and hill-climbing ability. The Graham-Paige is regularly started in second speed, first speed being used only in mud or sand. In third speed



CHRYSLER SHACKLE

Spring ends of "65," "75," and "Imperial 80" are anchored in blocks of live rubber



OAKLAND POWER PLANT

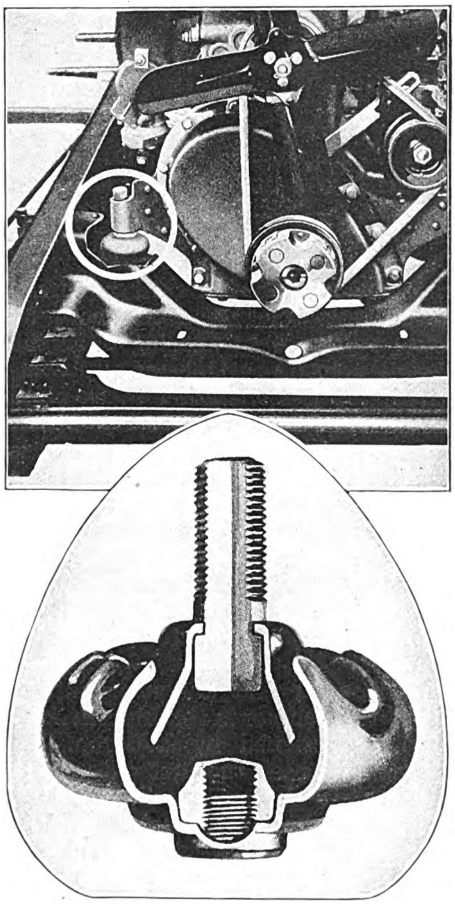
Right side of the improved Oakland engine showing the larger carburetor, new oil-wetted air cleaner, and gasoline pump that supersedes the vacuum tank. Note engine supports

this car is said to have pulling power ordinarily obtained by second speed, yet this third speed is capable of driving the car at 50 or 60 miles an hour without the usual gear noises.

Chrysler has brought out the Isotherm Invar piston for the "65," "75," and "Imperial 80," which, through the modification of the Invar strut piston head and the application of tongue and groove piston rings, effects a revolutionary kind of piston cooling, an advanced mode of cylinder wall oiling, and new provisions for combustion sealing. Other significant mechanical advancements have been made by Chrysler this year but lack of space prevents our mentioning any of them except the rubber mounted engine of the "Plymouth," the smart new four-cylinder model that has set the "dress" style for the newer cars. This mounting involves a three-point support, with the single point in front and the two rear ones, each built of interlocking "U" sections separated by a rubber cushion.

The new duPont, introduced but a few months ago, has been accorded an enthusiastic reception. It belongs in the higher price class, has a 141-inch wheelbase, and an eight-in-line L-head type motor. It develops 125 horsepower at 3200 revolutions per minute.

The new All-American six announced by Oakland recently is new and original in outward appearance and has many chassis refinements. Prominent among these, are the improved power plant with larger cylinder displacement, new internal-expansion four-wheel brakes, sturdier frame, Lovejoy hydraulic shock absorbers, and improved steering mechanism. On test, the power plant has developed 68 horsepower at 3000 revolutions per minute. To minimize transmission of vibration to the chassis and decrease noise, the engine is mounted on four supports, each completely insulated from the frame by a rubber "biscuit," leaving no metallic contact between engine and frame. Another feature used for the first time this year is the provision, on the frame, for integral bumper mounting.



OAKLAND ENGINE SUPPORT

Above, in circle, is the rubber "biscuit" support and below is a sectional view of it

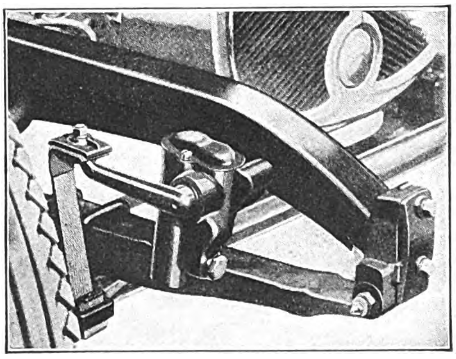
Buick will exhibit no new models at the show this year. Precedent in line and color treatment, however, has been ignored by Buick, and although the new bulging body styles have been criticized by some people, others like them because of the greater roominess. One innovation added by Buick is an adjustable driver's seat. By shifting a simple, conveniently placed lever, the seat may be pushed forward or backward to suit the length of the driver's legs.

Perhaps the most outstanding development of the year is the new series of six-cylinder Chevrolet cars to take the place of the present four-cylinder line which will now be discontinued. Seven models of passenger cars and three commercial types comprise the line.

Included in the passenger series are five closed and two open models, no one of which is more than 30 dollars above the price of the four-cylinder model which it replaces. In this new line, all bodies of which carry the famous Fisher stamp of craftsmanship, a new convertible landau sedan supplants the imperial landau and a phaeton takes the place of the old touring car.

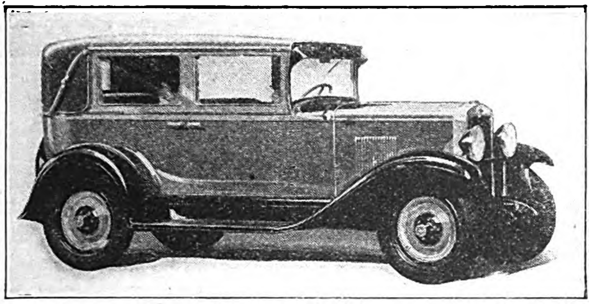
In this new offering Chevrolet has retained the highly successful valve-in-head principle. The motor is of the high compression type with a non-detonating head and is said to develop 32 percent more power than its predecessor. The speed has been stepped up to satisfy maximum requirements, and, in acceleration, the new motor is superior to any previous Chevrolet model. This remarkable acceleration is due partly to the use of a new accelerating pump. When the accelerator is suddenly depressed, this pump forces a small quantity of gasoline into the manifold of the carburetor, giving the car the instant power and getaway so necessary in modern traffic. On actual dynamometer tests the new engine develops 46 horsepower at low engine speed. At all ordinary speeds it is said to develop from three to four times the amount of power required to drive the car. It is also said that, under ordinary driving conditions, the new engine will show an economy of better than 20 miles to the gallon of gasoline.

In the new engine the heavy 46-pound crankshaft, balanced statically and dynamically, makes torsional vibration imperceptible at all speeds. Thus this engine is very quiet in operation. Au-



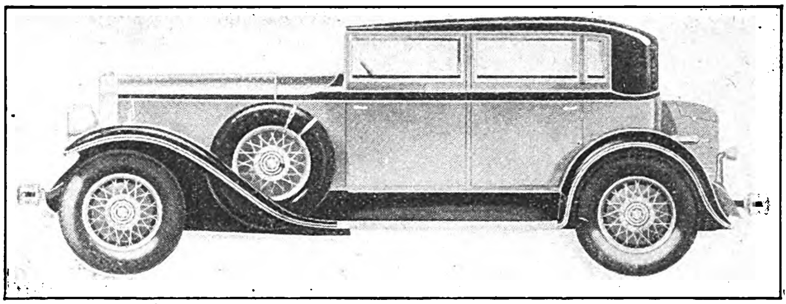
OAKLAND FRONT SPRING

View illustrating integral bumper mounting and the hydraulic shock absorbers



CHEVROLET CONVERTIBLE LANDAU

This convertible landau in the six-cylinder series takes the place of the former four-cylinder imperial landau



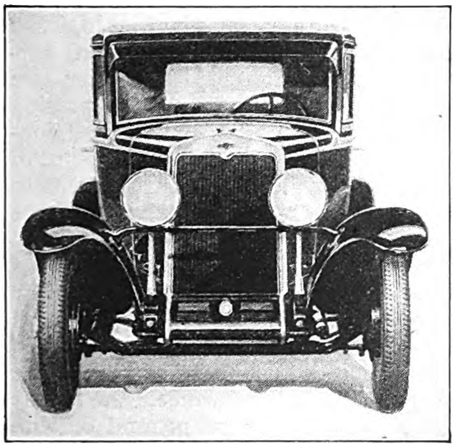
FRANKLIN GENTLEMAN'S SPORT SEDAN

This body design classic on the Franklin chassis is by Derham. It is finished in Caribbean red with six wire wheels in Bengal yellow, and black leather roof

tomatic lubrication of the entire rocker-arm mechanism and of all valve-operating parts conduces further to quietness of operation.

Chevrolet engineers have installed in the new engine a new type of AC air cleaner; a new method of self purification of the crankcase oil; an improved system of crankcase ventilation; and a new rear axle which has a 3.8 to 1 gear reduction between the engine and the wheels. The new rear axle is similar in design to that used on high-priced cars.

All the new Chevrolet models are equipped with the Alemite lubrication system, theft-proof ignition locks, fixed-focus type headlamps operating from the lighting switch with a toe button dimming control, and a number of other new features too numerous to mention here. The dimming control is a button switch located at the left of the clutch pedal, by means of which the light shaft may be deflected. Another noteworthy feature is that all closed models of the new Chevrolet six have adjustable driver's seats. All models have non-locking four-wheel brakes and also rear service brakes in two self-aligning segments.

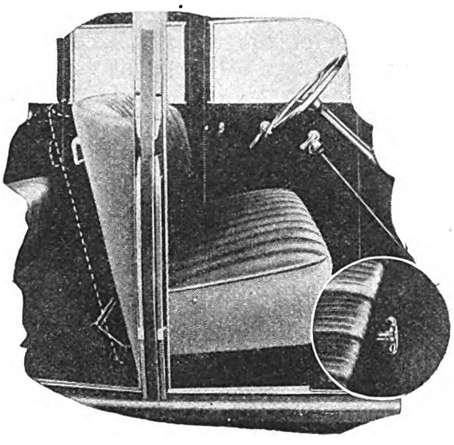


CHEVROLET FRONT

Note the sweeping fenders, chromium plated trim, and other features of the new models

The air-cooled Franklin is one of the few cars that will show distinctly new models this winter. Four of the country's leading custom body designers and builders — Willoughby, Dietrich, Derham, and Holbrook—will exhibit coach-work on the Franklin chassis at the custom salons. Willoughby's contribution is an all-weather town car; Dietrich's, a convertible victoria brougham; Derham's, a gentleman's sport sedan; and Holbrook's, a convertible coupé. Besides these models, Franklin apparently will announce nothing radically new this year.

Stearns-Knight is another that will exhibit three new models on its straight-eight chassis. Two of these, by Brunn, are: a convertible coupé and an all-weather cabriolet. The third, by Judkins, is an enclosed drive limousine.

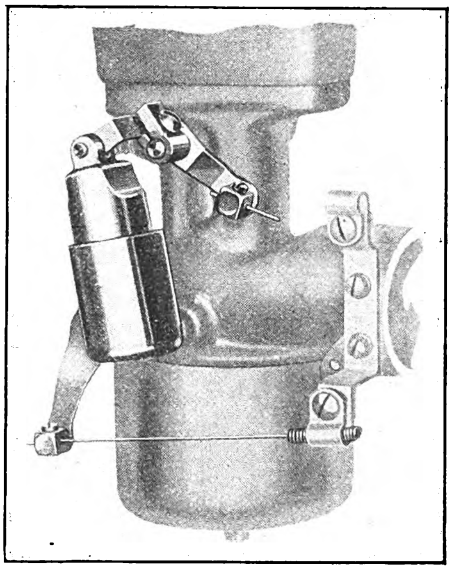


CHEVROLET ADJUSTABLE SEAT

Device for adjusting driver's seat to the length of driver's legs, on closed models

The Kissel Motor Car Company will announce no new features or models. It is to be remembered, however, that this company pioneered in many points of design, noteworthy among which is the cushioning in rubber of springs, motor, and other major units.

Velie also will have no new models or improvements to exhibit.



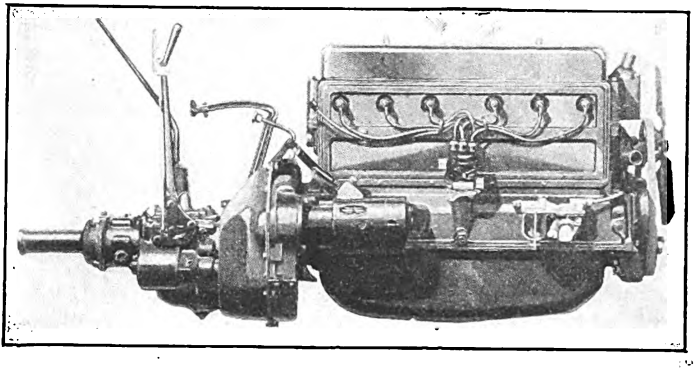
CHEVROLET ACCELERATING PUMP

A new device which gives better "get-away" when the accelerator is depressed quickly

Information on other cars was promised but, unfortunately, did not reach us in time to be included in this survey although the time allowed for its preparation was a full month. In this group are: Oldsmobile, Cunningham, Hupmobile, Pierce-Arrow, Reo, Locomobile, Jordan, Chandler, Cleveland, and Stutz. The Nash Motors Company stated that it would be impossible for them to release this information to us so far ahead of the show; McFarlan was discovered to be bankrupt; and other manufacturers of whom information was requested, failed to answer our inquiries. This last class, including the lower priced cars such as Ford and Whippet, apparently has nothing significant to announce.

CHEVROLET MOTOR AND TRANSMISSION

View of the right side of the new six-cylinder motor. The motor has a three and five sixteenths inch bore and a three and three quarters inch stroke. It has a high compression, non-detonating head and is fully enclosed. It is claimed that the new six develops 32 percent more power than the discontinued line of fours



Wheels—III

Steering Wheel Linkages, Castor Settings of Wheels, and Reasons for Wheel Wobble Are Discussed In This Installment

By P. CORMAC, F.R.C.Sc.I., M.R.I.A.
University College Dublin

(Concluded)

MANY devices have been invented to give deflections to the steering wheels so that their axes intersect on the back axle produced. Jeantaud's modification of Lenkersperger's invention was simply to set the steering arms so that, instead of being parallel in the mean position, they converge to some point on the propeller shaft. Jeantaud's gear is shown in Figure 21, December, 1928, issue. With this setting of the steering arms, the necessary excess deflection will be given to the inner steering wheel on a curve. This can be seen from the fact that when the coupler is pulled over to deflect the wheels, Figure 22, the effective lever arm, that is, the perpendicular from the steering pivots on the coupler, increases for the outer wheel and diminishes for the inner wheel. Hence, as with a small pulley and a large one connected by belting, the wheel with the smaller lever arm is deflected the more. The equivalent pulleys for the Jeantaud linkage in the position of Figure 22 are shown dotted.

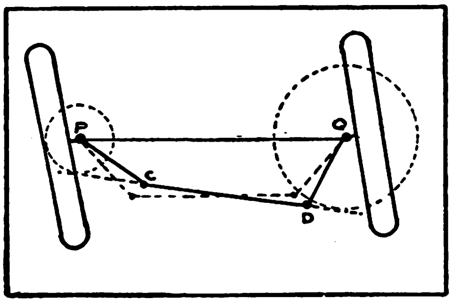


FIGURE 22

In this almost universally used linkage, the inner wheel turns more than the outer

This linkage, however, gives but approximate concurrency to the wheel axes. Deflections are correct in but two positions. The first position, of course, is when running straight. The second is when the wheels are deflected to an angle usually in the neighborhood of 30 degrees. From zero to 30 degrees of lock, the deflection given to the inner wheel is less than that necessary for concurrency. Beyond 30 degrees the deflection of the inner wheel is greater than that required for concurrency. The gear thus gives the steering wheel axes intersecting some two feet behind the back axle at the beginning of the steering movement, intersecting on the back axle when the deflection of the inner wheel is 30 degrees, and intersecting some two feet in front of the rear axle at the angle of maximum lock.

The length of the steering arms and the track rod are calculated to insure this. The rate of growth of the error becomes very rapid for large deflections. Where uncommonly large deflections are to be provided for, as in long wheelbase trucks and in taxicabs, the track rod should be placed on the outside of the axle; in this case the steering arms diverge as from a point on the propeller shaft, the track rod being some two inches longer than the pitch of the steering pivots. With the outside track rod, the rate of growth of the error for large deflections is less than with the inside coupler.

FOR correct steering to obtain when running straight or nearly straight, the steering arms should converge to a point on the propeller shaft at a distance equal to half the wheelbase from the track rod. This holds both for inside and outside track rods, and incidentally shows that a blunter setting of the steering arms is necessary with the outside track rod. Usually the point towards which the steering arms converge in their mean position lies farther to the rear, thus giving correct steering on sharper curves. A setting which gives correct steering for a deflection θ of the inner wheel is to make the steering arms converge to a point distant $(w + 2r)$ divided by $(1 + 1.63 \cos \theta)$ from the front axle. In this formula, w is the wheelbase or distance between front and rear axles, r is the length of the steering arm and is to be taken as positive for an inside coupler and negative for an outside coupler. The design formula given may be used to calculate the angle at which an existing gear gives correct steering.

The Lavenir concave pentagon gear, Figure 23 (a) and the Jenatzy divided coupler, Figure 23 (b) are improvements on the accuracy of the Jeantaud gear. Both these designs are valuable in trailer steering in which a tractor bar, pivoted at *R*, rotates *RB*, with it when curving. The divided coupler becomes essential with the independent suspension of steering wheels recently introduced.

A steering gear giving mathematically correct conditions was invented by Bourlet. This mechanism is shown in Figure 24. Here the coupler was placed in guides so that it could slide across at a fixed distance in advance of the front axle. Pivots at the ends of the coupler operated in slotted levers, forming the steering arms. The arms are set so as to converge to a point at a distance equal to the wheelbase in advance of the front axle. The great drawback to this gear lies in the sliding joints. Wear of these and the consequent rattle when worn render it less suitable than the approximately correct linkages consisting entirely of turning pairs.

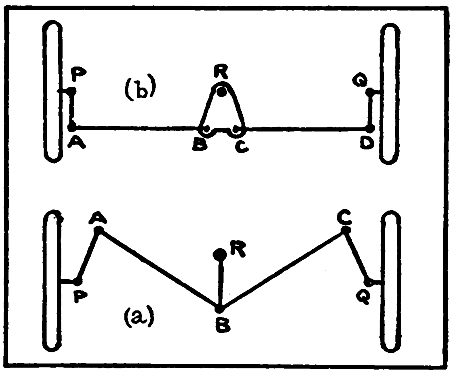


FIGURE 23

These two forms of steering wheel linkages — see text — are improved types

To reduce the lever arm of the road resistance and shock on striking obstacles, the steering pivot is sloped so that it points downwards and outwards. In Figure 25 the center line *KV* of the pivot is shown passing through the point of tire and road contact. Generally, however, the point of tire contact will be from three eights to three inches outside the trace *V* of the pivot axis *KV* on the ground. The common view that there is no swerving effect due to road resistance, when the pivot axis passes through the center of the tire contact area, is incorrect. To protect the wheel from the swerving effect of road resistance, the pivot axis should strike the ground outside the point of tire contact, or else the pivot should be given a forward rake sufficient to bring its trace on the ground at the effective center of contact which, as we have seen, is some .2 to .3 inches ahead of the center line.

OCCASIONAL obstacles on the road may, for the moment, give this point a much greater advance; an obstacle one inch high places it five and one half inches in front of the geometrical center. It is, however, undesirable for two reasons to have a true center-point setting. An out of center setting makes it easier to turn the steering wheel with the car moving slowly. This is because the turning of the wheels in the steering sense causes as well a rolling motion of the wheels around the pivot trace. The ease, due to tire creep, in turning the steering wheels of a car in motion, as compared with turning the wheels on a stationary car, is well known and comes into play here.

THE second reason against centering the pivot over the center of tire contact is that it makes the shock on the stub axle due to road irregularities unduly great. With the pivot off center, the first effect of a blow on the tire is to swerve the wheel. The elasticity of the steering gear and its reversibility allow of this taking place to a certain extent and the inertia of the wheel in taking up an angular deflection absorbs a large part of the effect of the blow so that but a cushioned effect reaches the stub axle.

With inclined king pins, without, however, true center-point steering, the weight of the car tends to return the wheels to the straight as in the case of the scooter. But the restoring couple due to weight is extremely feeble with the usual settings.

In addition to pointing downward and outward the king pins point some two to fifteen degrees forward. This gives a nominal castor effect of from one half inch to four inches so that the wheels trail as in the bicycle or furniture castor. In this castor action both wheels must be considered as one unit. This means that castor setting will not obviate serious consequences in the event of breakage or disconnection of the steering linkage unless it be combined with a setting which gives true center pivot steering. Center point steering has a real advantage in safety in the event of a burst tire and again in tire durability.

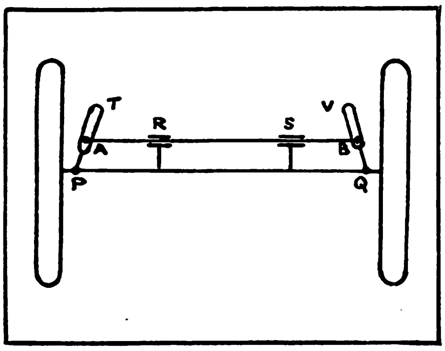


FIGURE 24

The Bourlet gear uses undesirable sliding joints, but is mathematically correct

A second method of obtaining castor action is to offset the hub axes behind the plane of the steering pivots. An offset of one and one half inches is used on some continental cars.

Castor action is the principal cause of the tendency of wheels to straighten out automatically after curving and mainly on account of the centrifugal force of the car. Castor setting is illustrated in Figure 26.

We must now draw attention to a further refinement in the setting of automobile steering wheels. The setting referred to is known as toe-in. Measured in front, the tires are one third to three eighths of an inch nearer together than at the back of the axle. This setting can be adjusted by altering the length of the track or tie rod. It gives stability to the straight course and helps in straightening out the steering after turning.

THE action of toe-in in lending stability to the straight course of the vehicle is illustrated in Figure 27. Both mid-pivot and divided-pivot systems are shown. Taking the motion to be in the direction of the arrow and assuming the left wheel to be retarded by an obstacle, the wheels are so deflected that the left wheel becomes edge on to the obstruction while the right wheel is put more broadside on to the direction of motion. The right wheel thus partly rolls and partly drags over the road, thus developing a resistance which counter-balances that due to the obstruction at the left wheel. Once the obstruction is passed, the extra resistance at the right wheel will pull the steering back until both wheels are again traveling with equal broadside on as originally.

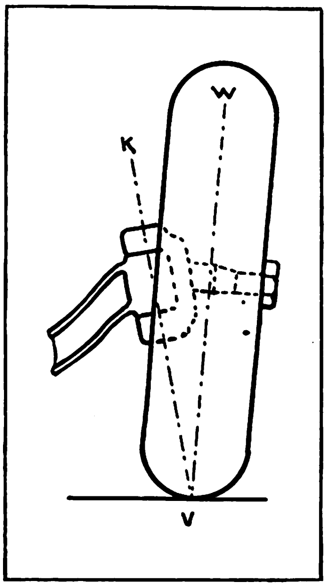


FIGURE 25

True center point setting is undesirable for the two reasons mentioned in the text

The geometrical inaccuracy of the ordinary steering linkage of the automobile adds virtually to the toe-in for small angles of lock.

Want of sufficient toe-in in a horse carriage or trap manifests itself in a continual swaying of the shafts to right and left. The action of toe-out on front auto wheels may be observed when reversing, or better when steering a car running backwards down a grade, or again by a model toy cart run on a sloped board.

The interplay of forces and inertias in front automobile wheels give rise to a vibration called wheel wobble. The steering wheels and gear deflect rapidly right and left, and the front end of the car vibrates in sympathy. Speed wobble has the same frequency as, and is accompanied by, criss-cross vibration of the front axle; that is, a vibration in which one end of the axle is up when the other end is down. This crosswise axle vibration may have either a high or a low frequency. The high frequency (ordinarily about 250 to 500 per minute depending on the car) occurs under the combined action of tire and chassis spring forces. The low-frequency oscillation occurs as a forced vibration of small amplitude as the axle follows the swaying of the chassis on its springs. This frequency is of the order of 100 to 150 per minute. In addition, certain road waves running askew across the wheel tracks so that one wheel is on a crest when the other is in a trough, will give a criss-cross vibration, the frequency of which depends on the car speed and wavelength.

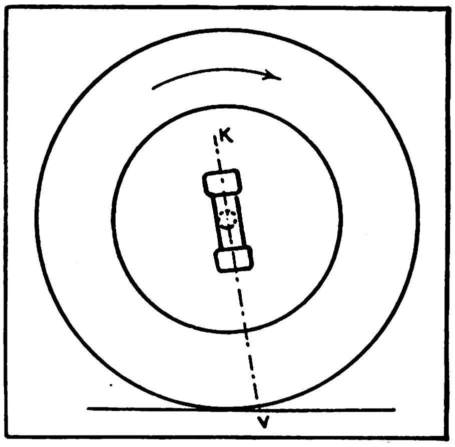


FIGURE 26

Castor setting, shown here, causes wheels to straighten automatically after steering

IN experiments by the author on a Ford car, the axle vibration frequency was 250 per minute. The chassis side-sway vibration had a frequency of 144 per minute. The steering oscillation in a wobble developed by this car had a frequency of 250 per minute, thus verifying the isochronism of wheel wobble and axle vibration. The wobble occurred at about 11 miles per hour; that is, at a wheel frequency of 125 revolutions per minute. It would appear that the wheels initiated a chassis oscillation, the secondary harmonic of which forced a sympathetic oscillation on the axle, or out of round (elliptical) wheels gave an axle vibration of twice the wheel frequency.

In an endeavor to throw further light

on this phenomenon, the front of the chassis was jacked up so that the axle assembly depended from the front spring. The axle frequency was now determined by the tuning of an oscillation forced by hand on the wheel hub. Both wheels were then set in rapid rotation by pulling off a length of cord previously coiled round the hubs. Upon causing the front axle to oscillate, the wheels were observed to turn in and out in the same period. Again, if the steering wheel was oscillated by hand at axle vibration frequency, a violent isochronous criss-cross vibration of the axle was set up.

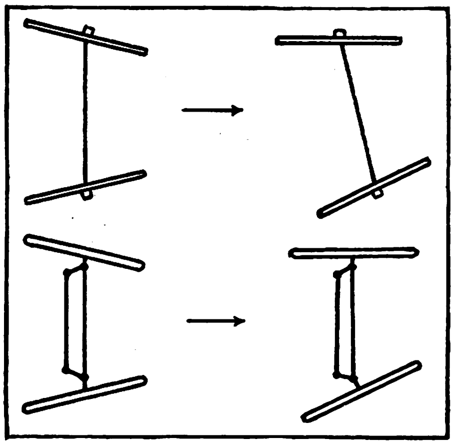


FIGURE 27

When steering wheels toe in, the effect is to keep the vehicle on a straight course

Want of balance in wheels or tires, or tires out of round would initiate and sustain this type of axle vibration when the revolution speed of the wheels coincided with the natural frequency of the vibration. A pair of unbalanced tire valves weighing five ounces, would, at 10 inches radius, give a force of 50 pounds on each wheel, causing a rocking couple on the axle of over 216 foot-pounds at 45 miles per hour. At nine miles per hour, the unbalanced force on each wheel is two pounds and the rocking couple nearly nine foot-pounds.

NOT merely static balance but also dynamic balance of wheels is essential if this source of vibration is to be eliminated. A wheel may be in static balance but not in dynamic balance. Ordinarily the weight of the valve puts a wheel out of static balance; that is, the wheel will come to rest with the valve at the bottom. Some makers balance the valve so that there is no tendency for any part of the wheel to swing to the bottom when free to rotate on a jacked-up axle. For dynamic balance, the tire and rim must be symmetrical with respect to the axle. If, in replacing a rim, the bottom be pulled farther on than the top, we get a wheel with dynamic unbalance. Such a wheel appears to wobble when rotating; it is the askew setting of the tire that gives this appearance; the wheel itself does not turn in and out in the steering sense.

There is, however, a couple acting on such a wheel when running, the direction of the couple being such as would tend to pull the rim on straight. Such a couple will therefore tend to turn the wheels in and out in the steering sense, and, in addition, to rock the axle. The main cause of the turning in and out of the wheels in wheel wobble arises, however, from gyroscopic action.

A model constructed by the writer to illustrate the gyroscopic action of a front axle assembly is shown in Figure 28. Rapid spin can be imparted to the wheel by coiling a short piece of twine about the hub and pulling it off quickly. If the apparatus be now set vibrating as a pendulum about the horizontal axis through *A*, we get a display of gyroscopic effects. It will be observed that the wheel oscillates about the axis *KK* in such a manner that the hub traces out an ellipse in the reverse sense to the wheel spin; that is, the circulation of the hub is in the opposite direction to the wheel spin. This motion of the hub is called precession.

WHEN the pendulum is at the extremity of its swing, the wheel is passing through the middle of its swing about the axis *KK*. When the pendulum is vertical, the wheel is turned through its maximum angle about *KK*. It will be noted that the period of the pendulum vibration is considerably lengthened beyond what obtains with the wheel not rotating. This arises from the fact that the gravity-restoring couple on the pendulum which hurries it back from its extreme angle of swing is partly neutralized by a gyroscopic couple arising from the swinging of the rotating wheel about *KK*. The reduced resultant restoring couple on the pendulum generates reduced acceleration with a consequent increase in the time of the journey.

A second mode of vibration of this system is possible if properly started. In this mode, the wheel hub describes its ellipse in the same sense as the wheel spin. But now the gyroscopic couple due to the turning of the wheel about *KK* conspires with the gravity couple in hurrying the pendulum back from the end of its excursion. The increased acceleration generated results in the journey being accomplished in quicker time so that the period of this mode of vibration is shorter than the natural period; that is, the period without spin. As the hub describes its ellipse in the time of a vibration, we have a fast precession with the fast vibration, and a slow precession with the slow vibration. The two modes of vibration may therefore be referred to as fast precessional motion and slow precessional motion.

The behavior of the assembly under the action of an external force which should tend to hurry or to retard the precession depends on whether the precession is of the fast or slow type. For the slow precession we have Kelvin's rule: Hurry the precession and the top rises, retard the precession and the top falls. For the fast precession exactly the reverse rule holds. Applying the rule to the axle assembly, we find that hurrying the slow precession or retarding the fast precession causes the wheel to rise, augmenting the amplitude of the vibration and wobble, while delaying the slow precession or hurrying the fast precession causes the wheel to fall, minimizing and ultimately annihilating the vibration and wobble.

THE results, which have a very important bearing on the practical applications of gyroscopic apparatus, and on the problem in hand, may be verified by the model. The auto wheel is put "sleeping" (running without wobble) by hurrying the fast precession or by delaying the slow precession just as a top "goes to sleep" by the hurrying of its slow precession or by the retarding of its fast precession.

The equations of motion of a front axle assembly are of the same form as the equations for the Schlick device for steadying a ship at sea; these will be found in Gray's "Gyrostatics and Rotational Motion." Substituting average numerical values in the equations of motion, we find that the frequency of the fast precession increases but slightly with the car speed, and is at the usual speeds but little greater than the natural frequency of the crosswise vibration of the axle. Further, this frequency depends but little on the restoring couple on the tires; that is, on the "straightening out" effect.

The frequency of the slow precessional vibration, at a car speed of 45 miles per hour, is in the neighbor-

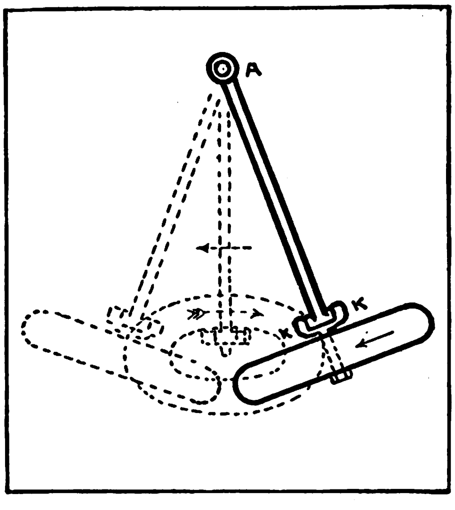


FIGURE 28

Gyroscopic pendulum illustrating wheel wobble. Drawn from model by author hood of 20 per minute, becoming less as the speed rises. Wobbles of this low frequency have not been reported, while there is considerable evidence to show that wobble of the higher frequency exists. We therefore conclude that high-speed wheel wobble is a case of fast precessional gyroscopic motion.

Remembering that fast precessional motion of the axle assembly is amplified by retardation, it is not surprising that inventors have been unsuccessful in finding a complete cure for this disturbance. (It may be shown, however, that fluid frictional damping forces do not tend to the instability of the system). The axle assembly requires hurrying of the fast precessional in order to reduce and ultimately annul it, or in other words to put the wheel sleeping. The slow precessional motion of the axle assembly is minimized and ultimately annihilated by retarding the precession, so that, ordinarily, tire and road reaction would quickly damp out this vibration.

It must be remembered that high-frequency wheel wobble may occur at any car speed. It is only when the axle disturbance arises from unbalanced wheels that a definite connection exists between speed and wobble. In all cases, however, the velocity in feet per minute is the wavelength of the road track multiplied by the axle frequency. For an automobile having an axle frequency of 500, we may expect wheel wobble at about 45 miles per hour if due to wheel irregularity, for at this speed the road wheels are making 500 revolutions per minute.

TURNING now to the low frequency of the axle vibration, that is, the forced vibration following chassis sidesway of from 100 to 150 swings per minute, we may remark at once that as the amplitude of this vibration is small, it will not usually give rise to wheel wobble unless there be slackness in the bearings and king pins, which, as far as the wheel is concerned, is equivalent to an increase in the amplitude of the axle swing. What has been said already of the precessional motions for high-frequency axle vibration applies here also.

We may have a wobble with a frequency of 100 to 150 per minute corresponding to fast precessional motion, or a wobble with a frequency in the neighborhood of 30, corresponding to slow precessional motion. The latter wobble would be quickly annulled by the natural forces between tire and ground, tending to retard the precession.

A point of importance bearing on the initiation of wheel wobble is that, to have gyroscopic apparatus exhibit fast precessional motion, the system must be properly started. The right wheel surmounting an obstacle and at the same time receiving a glancing blow giving it angular velocity inward about the king pin would appear to be favorable to the development of wobble.

The wobbles just discussed are seen to depend on the criss-cross vibrations of the front axle under spring action or forced oscillation. But with force action entirely left out of account, there is a natural mode of vibration of the steering wheels and front axle which partakes of a criss-cross vibration of the axle and turning in and out of the wheels in the steering sense. This is known to mathematicians as conical precession without torque.

It may be realized with the model of Figure 28 by continuing the stub axle above *KK* so that the center of gravity of wheel and axle is on *KK*, and then continuing the pendulum bar above *A* so that the centroid of the whole assembly is at *A*. Without rotation, the whole system is then in neutral equilibrium. With the wheel spinning and the pendulum properly started, steady isochronous oscillations about *A* and *KK* are possible, in which the restoring couple is a gyroscopic couple.

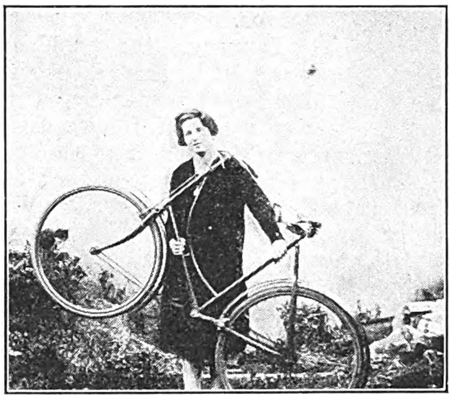


FIGURE 29

Gyroscopic action of spinning wheel aids when inverting a bicycle as shown here

Plainly, the mode of vibration here must be such that the gyroscopic couple at maximum pendulum displacement tends to restore it to its mean position. It is, therefore, the fast precessional mode which circulates in the same direction as the wheel spin. If properly started this type of vibration may be maintained by a front axle assembly. The equations of motion are now practically the same as before, with the couple terms omitted. Numerically we find the wheel revolution frequency to be in the neighborhood of 2.6 times the wobble or precession frequency. We are not aware if a wobble having this relation to the wheel speed has been met with.

If, however, we take the case of a loose king pin, or axle bearing, so that the wheel is free to precess about a horizontal diameter, the two moments of inertia concerned are those of the wheel about its axis and about its diameter, and we find the wheel frequency to be half the wobble frequency. As axle vibration isochronous with this wobble would be favorable to its development, we might expect it to be pronounced when it attains axle vibration frequency. As the wheels would be revolving at half this frequency, this would account for a wobble occurring at approximately half the speed of the ordinary high-speed wheel wobble.

A YOKING of the king pin which keeps it parallel to itself throughout the usual range of spring play, would, to a large extent, eliminate the above sources of wheel wobble. There would yet remain various effects which in favorable circumstances would give front-wheel wobble. For example, vibration of the chassis results in movement of the end of the drag link, which, with an improper setting, is moved towards and away from the steering arm. Thus, as the chassis vibrates, the wheels are constrained to deflect in and out to accommodate the varying position of the drag link. The wobble may have the same frequency as the chassis vibration, or it may have double this frequency. The double frequency will arise when the drop arm end is nearest the king pin in the mean position of the chassis oscillation.

We shall conclude by noting some of the effects of the pitching motion of the car, or what may be called "nose-diving." The frequency of this motion lies between 120 and 150. It has been stated that this is without effect on wheel wobble. We shall show, however, that motorcycle and motor-car wheel wobble may arise and be sustained from this cause. In pitching, the front axle rotates alternately with and against the wheel spin. The axle rotates with the wheel as the car nose-dives; it rotates against the wheel as it recovers.

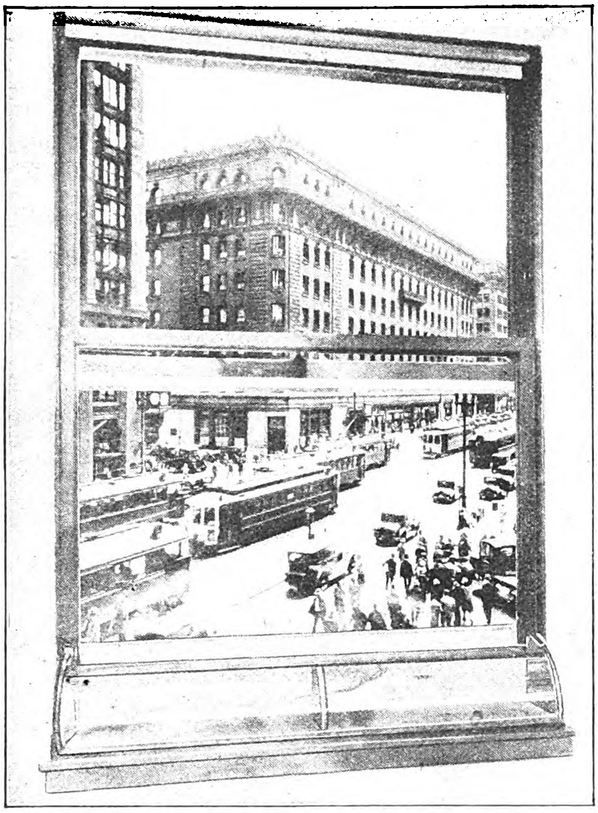
This remarkable action of similar and dissimilar wheel and stub-axle turnings is well exhibited by the model shown in Figure 28. If the wheel be spinning anti-clockwise and the supporting rod be turned about its axis in the same direction, nothing strange is noticed. If, however, the pendulum rod be rotated about its axis against the spin of the wheel, at once the wheel kicks up about *KK*.

A useful application of this principle is illustrated in Figure 29. In turning a bicycle upside down, the front wheel usually falls away awkwardly out of the plane of the frame. If, however, the front wheel be given a spin opposite to its usual running direction, it may be inverted over the rear wheel quite comfortably, the front wheel remaining steady in the plane of the frame. In bringing the machine back, the wheel must be spun in the other direction. Theoretically the speed of turning over should not exceed twice wheel speed.

THE END.

Noise Exclusion

Sound Waves From Noisy Streets Deflected by New Ventilator Which Admits Silent, Fresh Air



VENTILATOR TRAPS NOISE

Double reflectors permit fresh air to enter a room, but exclude the sound waves from noisy city streets

EXCLUDING street noises in congested business districts is closely allied with the problem of providing adequate ventilation for offices, factories, and other buildings. Were it not for the noise, the most economical and satisfactory method of providing fresh air would be by the simple process of opening a window. But every day new evidence appears to substantiate the belief that noise causes nervous strain and reduction in efficiency. In addition to this, noise must be blamed for considerable loss of health as a result of workers being confined in stuffy rooms due to the obvious fact that adequate ventilation frequently means an increase in the noise that enters with the fresh air.

AS described in an article by Dr. Donald A. Laird in our December issue, tests with an audiometer developed by the Bell Telephone Laboratories show the intensity of noise entering a room through opened windows. These experiments reveal that a single window opened half way increases the noise in the room by approximately 40 percent.

Among the recent efforts made to devise a practical method of reducing noise in offices, the work done by Dr. J. F. Newsom is significant. For a number of years Dr. Newsom has directed his attention toward designing and perfecting a device that will provide adequate ventilation, but will exclude or muffle the sound waves from adjacent sources of noise.

Recognizing the difficulty of a practical solution to the problem, his initial step was an investigation into the nature of sound waves of varying frequencies. After observing the effects of reflected waves in a mercury bath, shields were designed that would effectively blot out waves of a certain height and frequency, corresponding to "intensity" and "pitch" in actual sound waves.

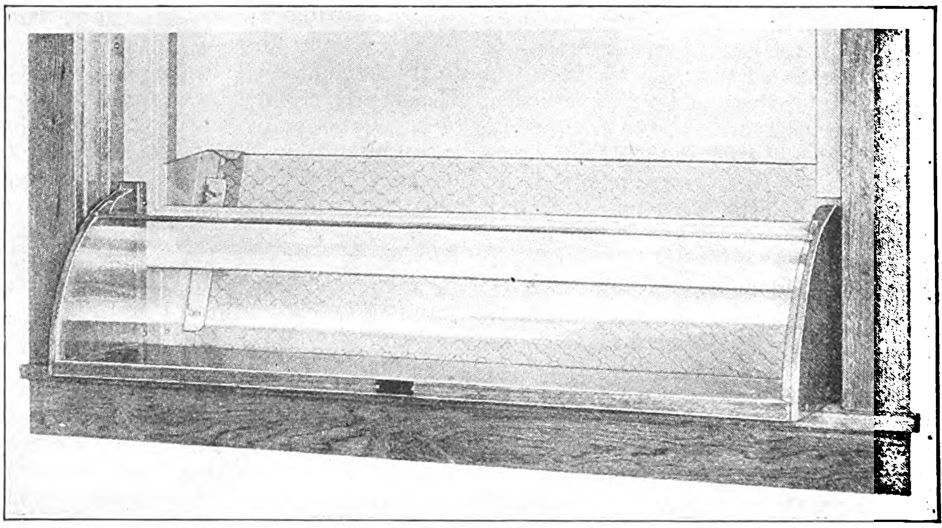
However, the problem was still far from solution, for street noises are of a multitude of frequencies. It was necessary to devise a method of measuring ear-drum annoyers such as those caused by surface cars, trucks, motor cars, horns, and whistles.

With the aid of a radio test-set equipped with a microphone of unusual sensitivity, it was comparatively easy to register the human voice, and certain other sounds. But it failed to furnish the necessary information about other important noises, such as the crash of a street car at an intersection.

The difficulty was met by using a Dorsey Phonelscope, which was installed in a second floor room at Leland Stanford University. By this device, the sound waves are caught in a horn and concentrated against a diaphragm, which is thus set in vibration. The vibrations move a small mirror which plays a reflected beam of light on a scale. By noting the readings on the scale, it is possible to obtain a comparative measure of the amplitude or intensity of the sound waves.

AFTER a series of tests calculated to show the nature of sound waves entering a window from various angles, a "window-muffler" was designed by which the sound waves are actually reflected back from the window-opening, in much the same way that light waves are reflected back from a polished surface. It was also found that the most efficient design is that using a double reflector placed at the proper angle in the window opening. Further tests showed it advantageous to have the inside shield curved in concave form, in order to reflect back the vibrations that would get past the outer shield. Testing the muffler on a fourth floor window, it was found to exclude about 75 percent of the noise coming up from the street.

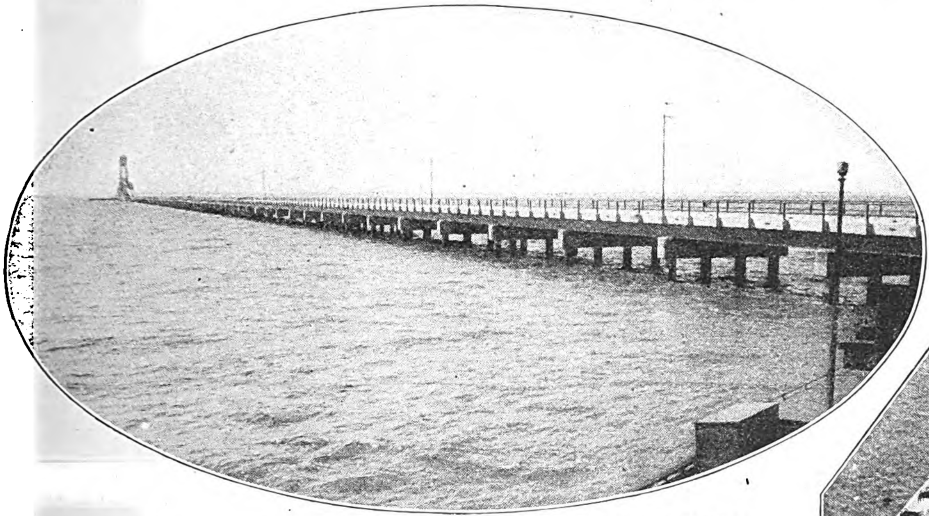
While science seeks more practical methods of deadening and reducing noise at the source, office workers will welcome a practical means of excluding the roar and clamor of the machine age without reducing the necessary supply of fresh air.



LESS NOISE FOR OFFICE WORKERS

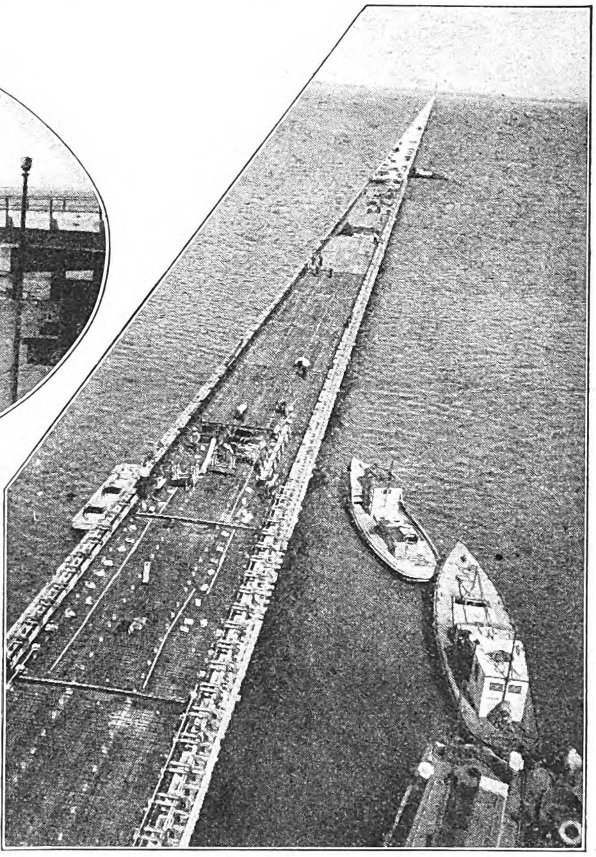
The device shown in this picture excludes about 75 percent of the exterior noise, allowing an adequate supply of fresh air to enter offices and hotel rooms through an open window

Long Bridge Shortens Coastal Route



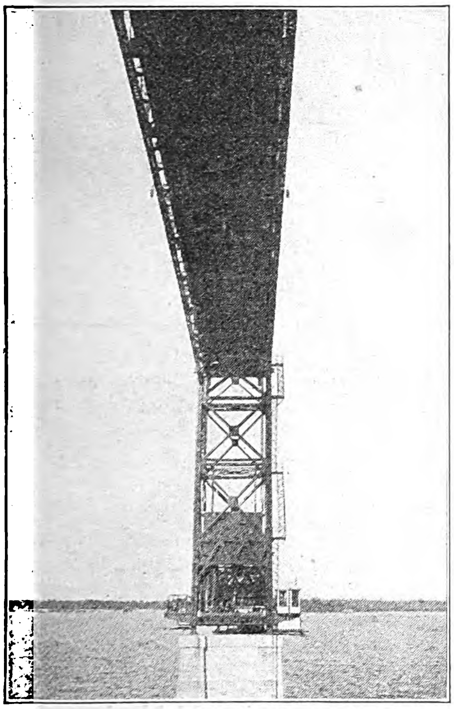
▲ COMPLETED END

In this photograph, taken at the completed end of the five and one half mile bridge, details of the piling and other construction are clearly apparent. The elevating span may be seen in the background at the extreme left



LAYING THE ROADWAY ➤

This striking view was made during construction of the concrete roadway. What appears to be a lighthouse in the far distance is the lift span which is but three quarters of the distance across. Motorists are now using the bridge

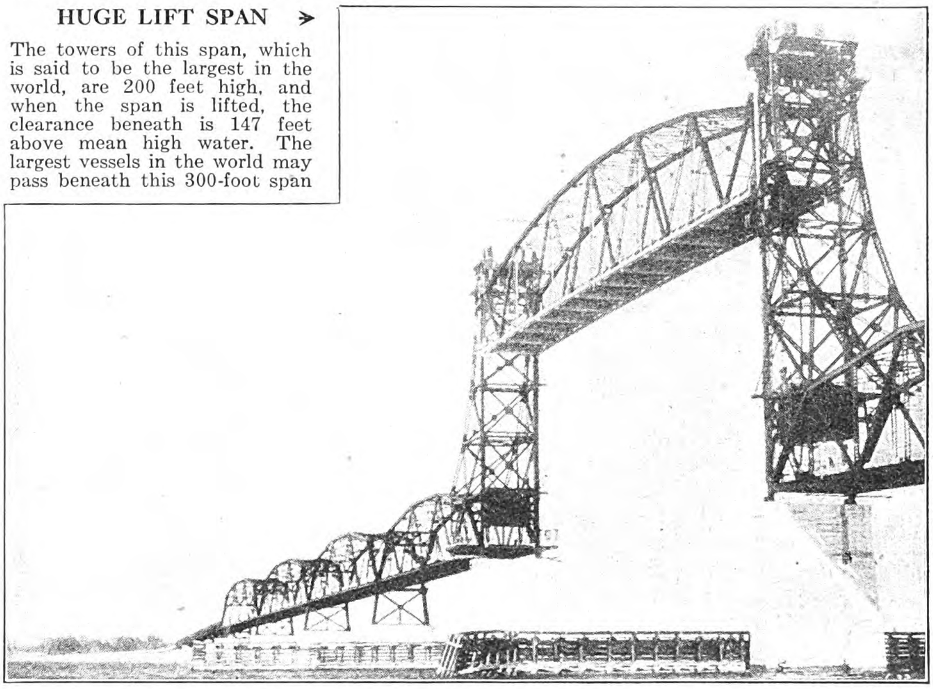


BENEATH THE LIFTED SPAN

This is what the motorist on the roadway near the span will see when it is raised

HUGE LIFT SPAN ➤

The towers of this span, which is said to be the largest in the world, are 200 feet high, and when the span is lifted, the clearance beneath is 147 feet above mean high water. The largest vessels in the world may pass beneath this 300-foot span



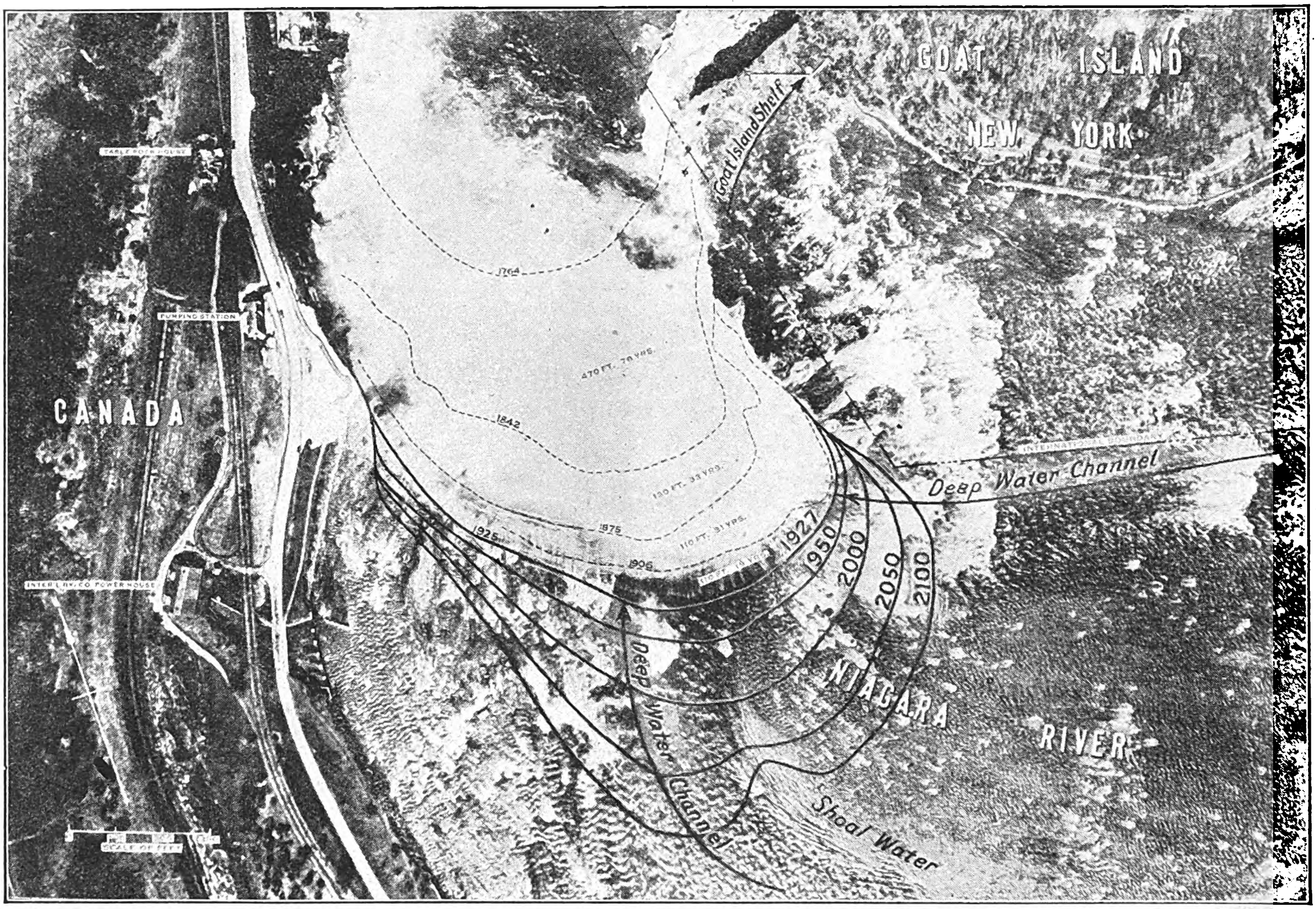
ONE of the longest bridges in the world and one of a chain of three which, with their connecting highways, form a crescent about the upper end of Hampton Roads, a new highway bridge over the James River near Newport News, Virginia, was opened to traffic in November. Governor Byrd officiated at the opening celebration which included a pageant depicting the history of the Old North State.

The new bridge is five and one half miles long, including the approaches, and provides a motor route between Newport News and Norfolk and Portsmouth, thus closing a gap in the Atlantic coastal highway. It is supported by concrete piles weighing up to 35 tons each and 115 feet long. These piles were poured on land, loaded on barges, and towed to the point of operations. There they were placed four abreast, seven feet on centers, and driven two at a time by a gigantic pile driver.

The longest lift span in the world is located about three quarters of the way across this bridge. It is 300 feet long and its lift is 147 feet above mean high water. When the span is in the raised position, the largest vessels in the world can pass underneath.

The floor of this bridge is a concrete surfaced roadway. Motorists who pass over it will, at times, be 50 feet above the water and, on foggy days will be entirely out of sight of land.

The engineering and construction work was carried out by the Turner Construction Company, New York City.



RECESSION OF NIAGARA FALLS—PAST AND FUTURE

Airplane mosaic of the Falls on which previous crest lines have been plotted and future crest lines are predicted. Note how the lip wears away faster at the points where the strongest currents plunge over and how the toe of the Horseshoe will widen, according to geologists

Niagara Should Be Saved

To Preserve Scenic Beauty of the Falls, Simple Remedial Measures Are Recommended by Special Board

IN recent years there has been much agitation for the preservation of Niagara Falls. Some pessimists have pointed to the past record of their rapid recession upstream—about 820 feet since 1764—and have insisted so long and vociferously that the Falls are "committing suicide" that the phrase has become a sort of catchword. Others have traduced the utilitarians for withdrawing water for the generation of power and thus detracting from the natural beauty of the Falls.

Actually, it is true that the Goat Island shelf within the United States boundary line, and the flank of the famous Horseshoe Falls on the Canadian side, are uncovered and practically devoid of water, and it is true, furthermore, that there is but a scant flow over the American Falls. This dewatering is not due so much, however, to the diversion of water for power purposes as it is to the natural recession, or cutting back of the notch, of the Horseshoe Falls. Water withdrawal has, in fact, probably helped to decrease the recession. However, this notch at the toe of the Horseshoe is now receding at a rate of only 2.3 feet per year, contrasted to its rate previous to 1906 of 3.7 feet per year, and is cutting in such a manner as to widen the crest of the toe. This widening will spread the water into a thin sheet and tend to lessen the cutting rate over any unit of the crest.

GEOLOGISTS have shown that the thickness of the upper layer of hard limestone on the floor of the upper rapids increases from 78 feet at the present crest to 130 feet at the head of the upper rapids. Since recession occurs not by wearing at the lip but by undercutting due to the fall of large blocks of stone, this increased thickness will retard recession in years to come. It is therefore highly improbable that the Falls will ever "commit suicide" and become a mere cascade.

It has long been a moot question as to whether the Falls are to be preserved in the full grandeur of their beauty for scenic purposes or further utilized for power generation by the diversion of more water. Either position is extreme and a solution of the problem seems to lie somewhere between these two views. For the purpose of determining what may best be done to preserve the beauty of the Falls and also allow further withdrawal of water, a Special International Niagara Board was created by the United States and Canada to study the situation thoroughly. Its interim report, just completed, recommends initial remedial works that, at reasonable cost, are considered most feasible to effect the desired results.

The Board has tested out on the

small-scale model built by the Niagara Falls Power Company the various types of remedial measures that have been considered. "These demonstrations," to quote the report, "have shown effectively that remedial measures which will improve the scenic value of the Falls are eminently practicable." Furthermore, such works, constructed at comparatively low cost, would make possible a thorough test of the effects of further diversion of water for power generation. If it is possible to withdraw more water from Niagara and, at the same time, have a more beautiful Falls, this would be of vital economic importance. Industrial development in Ontario depends largely on water power and it is claimed on high authority that, already, the power plants on each side of the Falls generate a total of electric power equivalent to 5,000,000 tons of coal yearly.

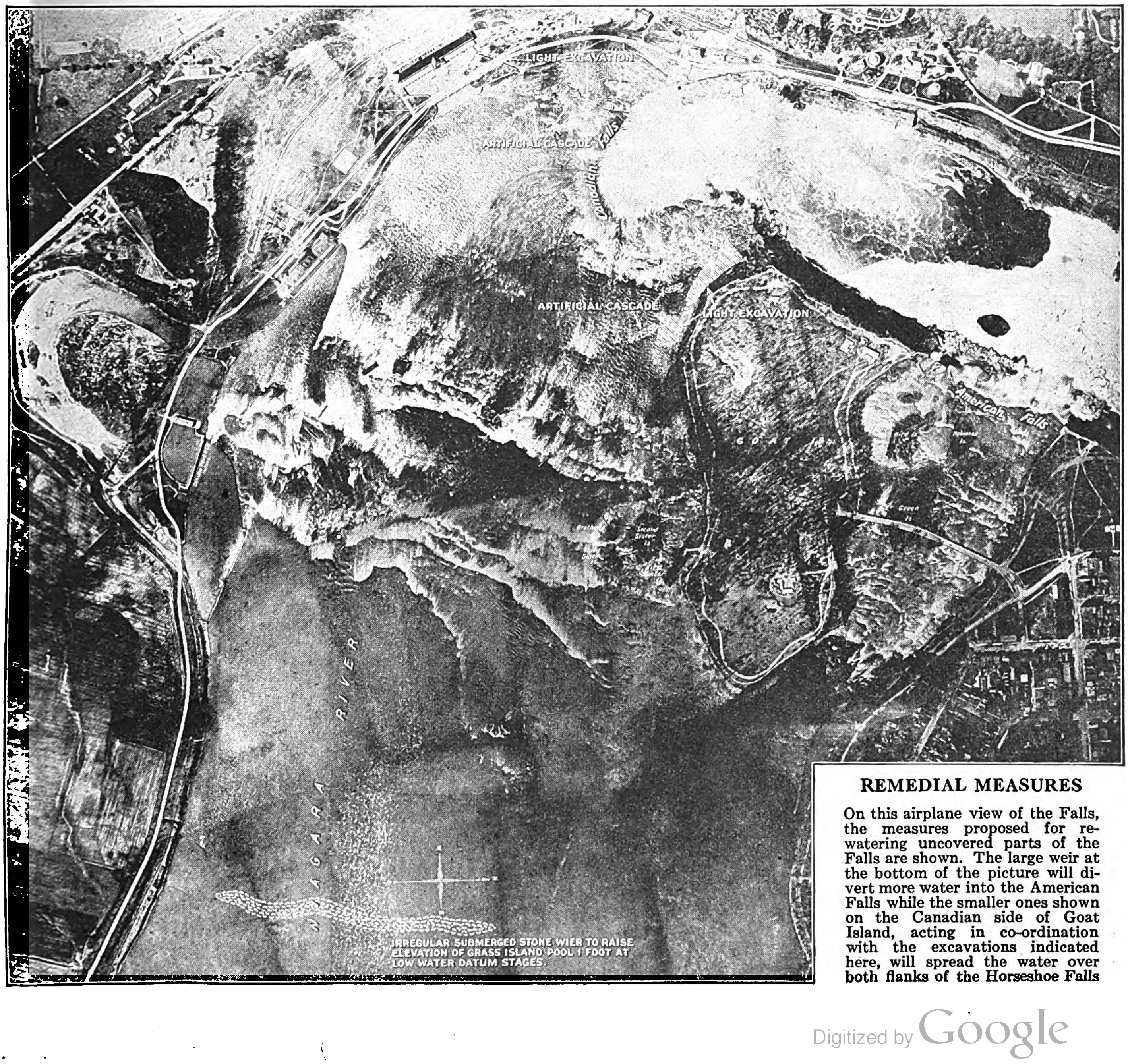
Of the initial works recommended by the Board, the re-watering of the Goat Island shelf is considered of primary importance because this feature is prominent and should carry enough water to bind the Falls into a harmonious whole. Submerged weirs with co-ordinated excavations designed to deflect the water from the central and northern heavy currents will, the Board concludes, distribute the flow over the floor of the shelf and to its crest. Since this work will be submerged to a fair depth, it will not be visible and will cause scarcely a ripple on the surface. Furthermore, it will not deflect enough water from the main crest to thin the water out into a white sheet instead of the green that at present is one feature of its beauty.

THE problem of replenishing the flow over the Canadian flank is not so serious, but the conditions at this point could be improved by the same kind of treatment.

The lack of volume of the American rapids and falls and of the flow around Three Sister Islands can be remedied by raising the level of Grass Island pool approximately one foot at low stages to throw more water against the head of Goat Island. A submerged weir is the logical method of raising this level. It could be of rubble-mound construction; would be quite inconspicuous; and so constructed as to cause no obstruction to the flow of ice.

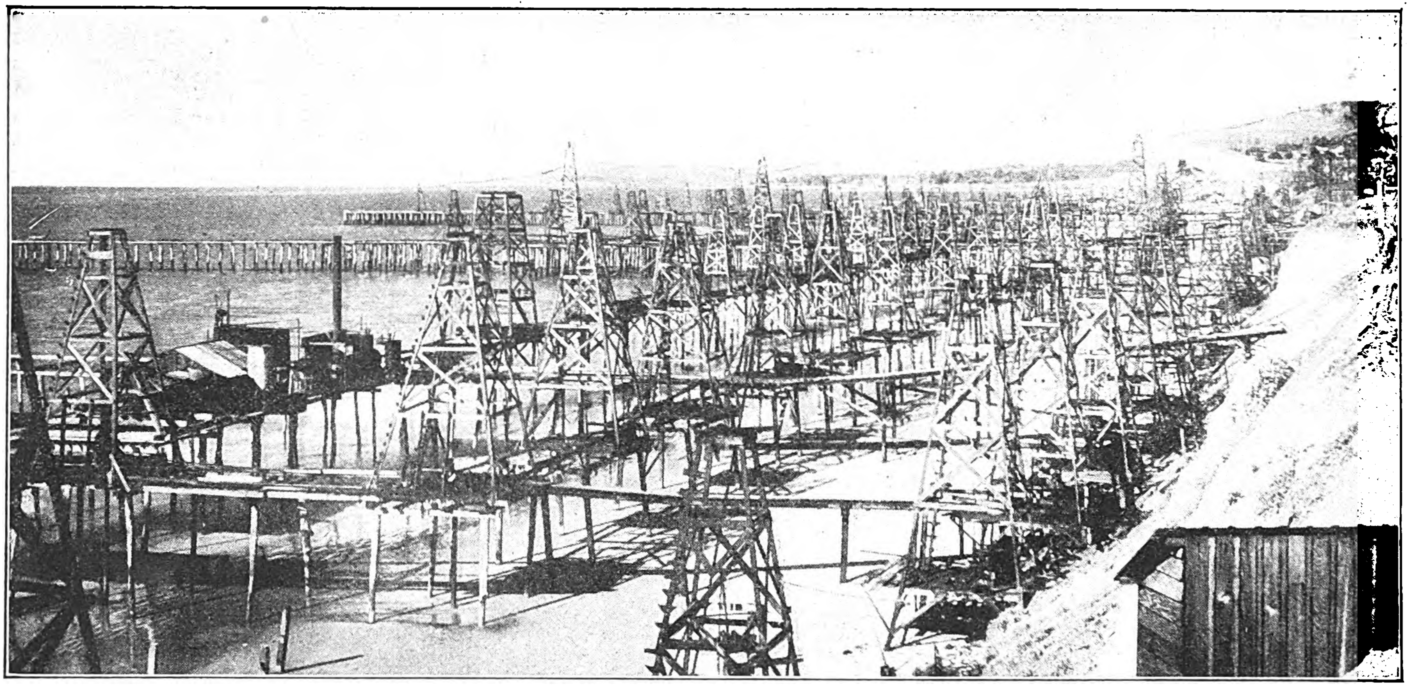
The Interim Report states: "The results to be anticipated from the construction of the works on the two flanks of the Horseshoe Falls will be the insurance at all seasons of an unbroken crest line from shore to shore, the maintenance of the present blended green and white color effects of the Horseshoe Falls, and, in some proportionate measure, a modification of the rate of erosion in the bend. The works in Grass Island pool will ensure an adequate flow in the American rapids and falls and between the Three Sister Islands.

"The Board is of the opinion that the construction of the initial works is highly desirable."



REMEDIAL MEASURES

On this airplane view of the Falls, the measures proposed for re-watering uncovered parts of the Falls are shown. The large weir at the bottom of the picture will divert more water into the American Falls while the smaller ones shown on the Canadian side of Goat Island, acting in co-ordination with the excavations indicated here, will spread the water over both flanks of the Horseshoe Falls



THE RACE FOR OIL. UNDUE CROWDING OF SEACOAST WELLS IN SOUTHERN CALIFORNIA

The Origin of Petroleum

Modern Scientists Incline Strongly Toward the Theory That Petroleum Is a Product of Once Living Matter

By HEINRICH RIES, Ph.D.
Professor of Geology, Cornell University

IN trying to determine the origin of petroleum, there are several questions which naturally present themselves, such as: 1. Is the petroleum an original substance or was it formed by the breaking down or alteration of some other material? 2. Did it originate in the rocks where it is now found, or if not, what was the source rock? and 3. If it did originate in some other rock, what was the cause or agent of transportation, which made it migrate from the source to its present place of accumulation?

FOR many years there have been two general theories regarding the origin of petroleum, known as the inorganic and the organic. The former states in general that all petroleum is of igneous origin, while the latter postulates that it has been derived by the decomposition of either animal or plant remains.

There is a well defined gap between the advocates of the two theories, and their views are practically irreconcilable. Curiously enough, the believers in the inorganic origin are mostly chemists, while those who have held that the organic origin is the true one are mainly geologists. Let us see just what these two classes of opinion are, and what each has for or against it.

The inorganic theory assumes in general that water or gases contained within the earth, act on certain chemical compounds, as a result of which hydrocarbons are formed. These rise toward the surface and accumulate in favorable spots.

OF the several inorganic theories advanced, that of Mendeléeff, proposed in 1877, will serve as an example. He supposed that iron carbides existed within the earth, and that if underground waters came in contact with these, hydrocarbons would be generated, a reaction that can be produced experimentally in the laboratory.

But while this theory may seem logical at first sight, there is considerable evidence against it. Thus, for example, if petroleum has originated by inorganic processes after the manner outlined, it must be regarded as of direct or indirect igneous origin; and if this is true, then why should we not find it in igneous rocks? There are hundreds of square miles of such rocks exposed on the earth's surface, yet hardly a case of petroleum occurring in them is known, and where any is found, it is in such close proximity to sedimentary rock as to lead us to believe that the oil has migrated from the latter into the former.

Or, to state another objection: Let us suppose for the sake of argument that the oil which is found in sedimentary rocks may have risen upward from underlying igneous ones. The oil may be in sandstones with shales above and below it. It cannot force its way through the overlying shales, and so it is not quite clear how it could have risen through the underlying ones.

One of the most interesting objections, curiously enough, has been supplied by Dr. C. F. Mabery, a chemist, who has pointed out that the nitrogen derivatives, which are formed in most, if not all, petroleums and natural gas, are conclusive evidence against the inorganic origin of these materials, since they can be derived only from matter which is of organic origin.

THE presence of helium has been appealed to by some as an indication of the deep-seated origin of both gas and oil, but little is known regarding the geologic occurrence of this element.

So, on the whole, the inorganic origin has little to recommend it. It may have attracted more attention than it deserves, because its few supporters have argued their cause actively, and very loudly, but no doubt sincerely.

The belief that petroleum is of organic origin was advanced at nearly as early a date as that of inorganic origin, for the well-known geologist J. S. Newberry in 1873 suggested that oil had come from plant remains which were buried in marine sediments and had after their entombment undergone a process of what he called destructive distillation, as a result of which hydrocarbon compounds were formed.

Practically all geologists and many others are now agreed that both oil and gas have been derived from organic matter, in most cases plants, although a few believe that animal matter made important contributions. This is reasonable when we consider that oil is found almost exclusively in sedimentary rocks, which often contain abundant plant remains in various stages of alteration, and furthermore that certain shales which carry considerable quantities of vegetable matter, will, on heating, yield hydrocarbon compounds similar to those found in oil, and which are liquid at ordinary temperatures. But here comes up another interesting question. Coal is admittedly of vegetable origin, and if we assume that petroleum is also, why was it that in some cases the accumulation of plant remains formed coal, and in others yielded oil?

WHILE we cannot yet answer this question definitely, it is probable that it depends on the composition of the plant debris, conditions of accumulation, and extent to which the plant material has been attacked by bacterial action.

In drawing a comparison between coal and oil, attention should be called to the fact that plant material shows a wide range of character, from the lower forms of plant life, like algae, the tissues of which are of a soft and even gelatinous nature, to higher types which develop woody tissue.

Now in studying coals we find that the identifiable plant remains which are to be found in them are usually of higher types, many of which develop woody tissue. There are, however, certain types of coals like the bog heads and cannels, which show very little woody tissue, but contain great quantities of spores, and remains of algae. The oil shales are similar. These materials all yield oil on heating.

This, then, suggests that some of the lower orders of plants may yield oil on decomposition.

If we look around for present day evidence of this we find that some sea weeds become covered with an oily coating while undergoing decomposition, and that the minute cases of some diatoms which lived by the millions in some bodies of water, are often found to contain globules of oil.

It is a well-known fact that when plant tissue undergoes decomposition under water, it is accompanied by the generation and elimination of by-product gases and some liquid hydrocarbons, the residue left behind being carbonaceous or coaly matter.

Now if we consider different types of plant material, contrasting woody tissue with that which is found in plants like algae, we find that in the case of those deposits of vegetable matter containing a large proportion of the remains of aquatic plants, these latter on dying may accumulate on the bottom forming a slime called *sapropel.* Such slimes or oozes are comparatively rich in hydrogen, and in the buried deposits of them the volatile matter may exceed 85 percent of the combustible matter.

This leads, then, to the belief that the sapropelic sediments are to be regarded as the effective "mother rocks" or "source beds" of petroleum.

What actually takes place has been well summarized by Dr. David White who suggests that the petroleum has been derived mostly from plants of low orders that yield waxy, fatty, gelatinous, or resinous products, mixed with which there may be more or less animal matter; and as will be mentioned later some believe the latter is an important source.

This organic matter may be deposited as organic detritus in muds or slimes, in both fresh or salt water. After aerobic bacteria had ceased to act on it, it was probably long subjected to slow deoxidation by anaerobic ones. The work of the latter results in the liberation of the hydrocarbon compound marsh gas or methane, which is the chief constituent of natural gas, and a common, although not large, constituent of petroleum.

The first part of the change may go on while the sapropelic material is accumulating on the bottom of the body of water and is called the bio-chemical stage. Later on when these slimes become buried under other sediments, the process continues during what is known as the dynamo-chemical stage.

The question may be raised, why any oil globules as soon as formed in the slime do not rise to the surface and float. The point is that oil globules do not tend to float in turbid water, but are drawn down by clayey sediment and held there.

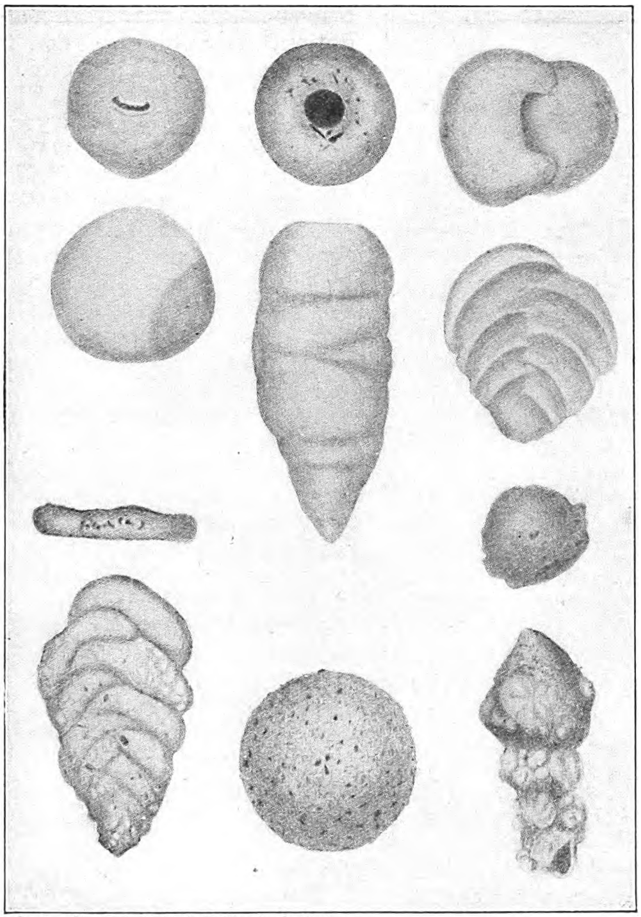
BEFORE carrying this discussion further, we may attempt to decide whether, if plants are the source material of oil (and gas), they were of marine or land types.

The argument in favor of land and fresh water types may seem to be the logical and stronger one, because land plants were probably much more abundant than marine forms. Then, too, the rock forming the source beds often gives evidence of having been formed in fresh water or, if not, in shallow water close to the shore.

It seems probable, however, according to Dr. White, that oils originating in fresh water or marine deposits do not differ much as to volume or quantity, but fresh-water deposits are thought by some to be purer, richer, and more widespread, although others hold to the view that the salinity of the water is essential to oil generation.

The importance of animals as source materials of oil is of problematic value even though the work of Engler, Hofer, and others has shown that it is possible to extract hydrocarbons from dead fish and other animal remains.

The objections offered to animals as a source material are that their soft parts are rarely buried in muds, and if they were entombed in sufficient quantity to form much oil, that the latter should show appreciable amounts of



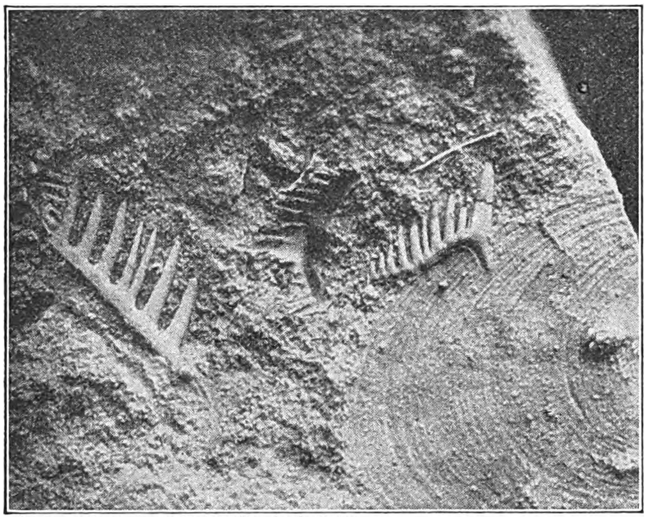
Courtesy Dr. Austin H. Clark, Smithsonian Institution

TYPES OF FORAMINIFERA

For diagnostic purposes these minute shells are of great importance in oil bearing deposits. The oil geologists now study them almost as closely as do the marine biologists phosphate of lime, which is contained in animal tissue.

On the whole, then, animal tissue probably contributes little in most cases, and so we turn to plants as the chief source of oil.

Given, then, the proper type of vegetable matter, accumulated and decayed under the conditions previously outlined, it seems evident that petroleum may form in sedimentary deposits, and that such rocks may also contain some carbonaceous matter.



Courtesy of Dr. Austin H. Clark, Smithsonian Institution

SUGGESTING ONE SOURCE OF OIL

Conodonts, usually held to be the teeth of small fossil fishes. From the black oil bearing shales of the Carboniferous Period

This rock, which may be called the source rock, is usually fine grained, and represents a type often found associated with the petroleum bearing rocks. It is not generally believed, however, that source beds form the reservoir rock of commercial oil pools, but that the oil has migrated from the former into the latter.

An important problem which has presented itself is the character of the original material in the source beds—that is, whether it was buried liquid oil, or a semi-solid wax which after burial was acted on by natural agencies and broken up to yield liquid petroleum.

THIS question has been brought up by the fact that in some rocks such as oil shales, no liquid oil is yielded to the well, but can be obtained by distillation, whereas in other source beds liquid petroleum is undoubtedly present.

It is difficult to conceive that enough heat was developed to distil the petroleum out of the source rock, as about 450 degrees, Fahrenheit, is required to accomplish this.

Pressure has been appealed to as a possible agent, but experiments along this line have not yielded very satisfactory results, although a slight quantity of soluble hydrocarbons can be developed in this manner or even by grinding.

A theory put forward by McCoy is, that while liquid petroleum may form in marine or brackish water oozes, it becomes wax-like as consolidation proceeds, through gases and connate waters, that is, those indigenous in the rocks, acting on it. If, however, before this occurs, structural conditions develop in the rock which will permit the oil to migrate into and accumulate in the reservoir rock, it will remain in a liquid condition.

If, then, no movements of the rock occurred before consolidation, the bituminous matter would all remain in the source bed. This is an hypothesis which still remains to be proved.

Since it is pretty generally accepted that the liquid petroleum migrates from the source rock into the reservoir rock where it accumulates, we may inquire what agents assist in this process. Among those which suggest themselves are heat, pressure, and water.

Heat hardly seems a competent agent, since in petroleum bearing strata the temperature, as a rule, is not very high.

Pressure may appeal to us if we think of the source rock as a compressible stratum, from which oil might be forced into less compressible and porous beds, but two difficulties present themselves at once. The first is that the mud forming the source bed may have been so compacted during settling and consolidation that it is not capable of much more compaction. The second is that if the pores of the reservoir rock are already filled with water, it is difficult to see how this could be compressed enough to make room for the oil being forced into it.

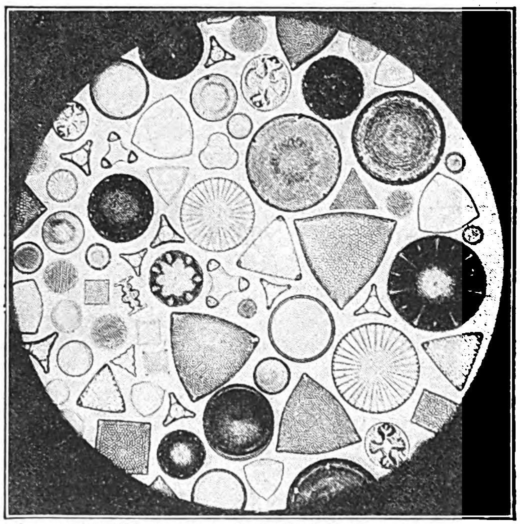
EXPERIMENTS made to throw light on the last named point have not been attended with much success.

The third agent, water, is more promising, but might be capable of acting in one of two ways. One theory assumes that the oil has been carried by moving water from the source bed into the reservoir rock. If such were the case, however, it would require the water to move from points of higher pressure, to others of lower pressure, passing across or through the source beds; but this assumption does not conform to the field evidence, because the source beds, owing to their fine texture, would not be very permeable, and moreover the different composition of the water often found in neighboring strata, is clearly against any such general circulation.

Any circulation due to gravitation also seems to be precluded because of the small size of the rock pores, especially those of the source beds, which may be .01 millimeter (one 2500th inch) or less.

A SECOND view, and one which seems to have much to recommend it, is based on the belief that migration of the oil is brought about by an interchange of oil and water, due to the physical properties of the two.

This can be illustrated by having a layer of oil-soaked shale next to a water-soaked sand. Under such conditions we find that the water migrates into the shale, and the oil into the sand, a phenomenon which can be demonstrated experimentally. The interchange is commonly explained as being due to the greater adhesion of the water for the shale particles. The water, therefore, draws itself into the finer pores of the latter, thus evicting the oil. The oil apparently breaks up into very small drops which migrate back through the water passages, until the material reaches a state of equilibrium in the sandstone. It is assumed that the source beds would have to be fairly well saturated with oil to make the process of interchange effective.



Courtesy of Dr. Heinz Rosenberger, Rockefeller Institution

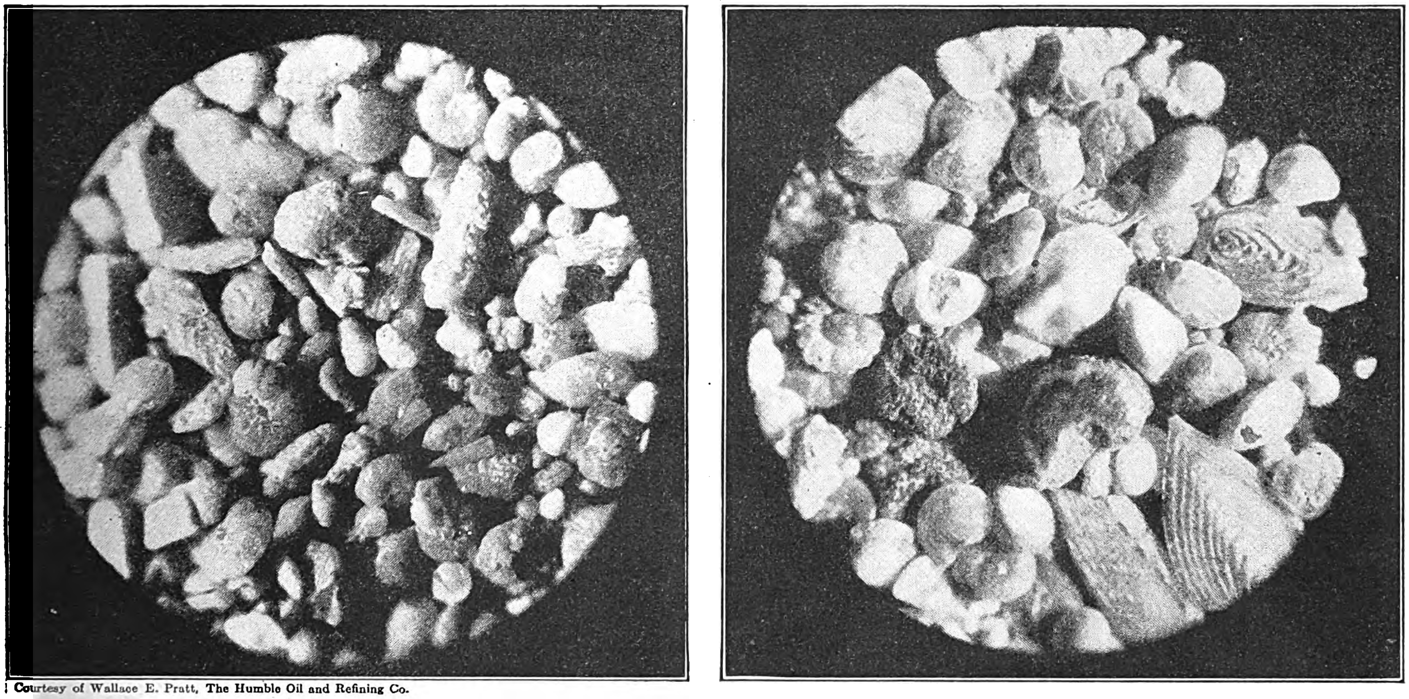
DIATOM SKELETONS

It was a long way from practical oil prospecting to the study of marine biology—until the connection was seen by the practical prospector

The oil, having entered the reservoir rock, some means must be at hand to concentrate it in "pools," as these accumulations of oil in porous rocks are called.

The original idea was that gravitative processes were responsible for the concentration of oil in pools, and this was developed to explain the original anticlinal theory of oil and gas accumulation. According to this, oil and gas were to be looked for in arch-like folds of porous rock, capped by a denser stratum. The gas, because of its lighter specific gravity, was thought to collect at the top of the arch, the oil below it on the flanks, and saline water, if present, farther down still. In other words it appeared as if these three materials would sort themselves gravitationally, moving up a bed until they met with some obstruction.

It is true that this principle seems to have much to commend it, and we find that where they occur in porous beds, both oil and gas appear to be closely associated with arch-like folds in the rocks. Indeed, this fact is, in general, made wide use of in the world-wide search for new oil formations, which is now going on. At the same time, experiments indicate that this gravitational separation does not take place by any means freely, very fine sands tending to impede greatly if not prevent it altogether. It does appear, however, that if gas is present below the oil and water it seems to assist the sorting process.



Courtesy of Wallace E. Pratt, The Humble Oil and Refining Co.

FORAMINIFERA FROM DRILL CUTTINGS FROM PETROUS OIL WELLS (MAGNIFIED)

Petroleum geologists now make the same use of these evidences that coal geologists make of plant fossils in correlating coal measures

The other way in which water may assist in the accumulation of oil, is according to what is known as the hydraulic theory. This view holds that circulating waters moving through the reservoir rock might carry small particles of oil in currents, until it reaches some eddy caused by structural conditions of the rock. Here it remains protected, while other oil particles join it until a pool is formed. The process may no doubt operate under favorable conditions. The objection which has been urged against the hydraulic theory is that there must be some place for the water to go, otherwise there would appear to be little possibility of any circulation.

Another possible explanation of the migration of oil in reservoir rock is gas pressure, for it is well known that gas is dissolved and occluded to a great extent in petroleum. As this gas tends to exert an expansive force, it is quite possible that it may assist the movement of the oil through the pores of the rock. It is certainly responsible for the uprush of oil through the drill hole.

There seems no doubt that even after petroleum has been formed in sediments, it may undergo a progressive change due to continued pressure and heat to which it may be exposed, just as is the case with coal. When peat, the mother substance of coal, is buried in the sedimentary rocks, it changes progressively to lignite, bituminous coal, and anthracite, which is represented by an increase in the carbon content, and a decrease in the more volatile constituents like hydrogen and oxygen. If, then, petroleum is buried in the same series of rocks, it too undergoes a change.

That there is some such relation has been brought out in a most interesting way by Dr. White, who showed that where the coals were of the rank of brown lignites, the oils were heavy, with a gravity on the Baumé scale of 20 degrees to 26 degrees, and that if the vegetable matter had been transformed to bituminous rank, the oils have in general attained a Baumé gravity of 35 degrees or more.

Where, however, the change of the coal has progressed to such a degree as to pass a fixed carbon content of 65 percent, figured on a pure coal basis, the oils which may have formerly been present in the same or underlying formations have mostly disappeared, although gas may be present.

Aside from this cause of variation in the rank of oil, it seems possible that filtration through the porous rocks may bring about a fractional separation of the original oil, and possibly explain the occurrence of some very light ones.

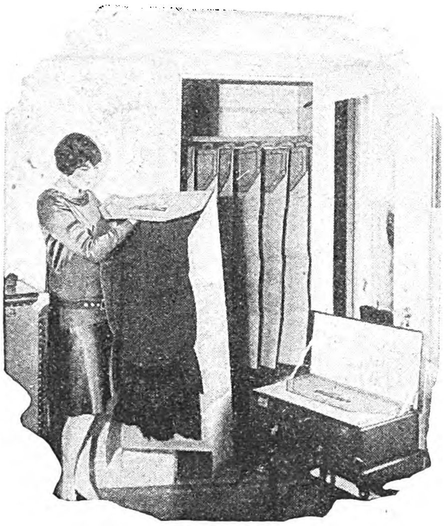
The petroleum having become concentrated in the pores or other spaces to form a *pool*, as it is called, remains there until tapped by the drill. These pools are found at depths ranging from 100 feet to over 6000 feet.

In conclusion, it may be said that it is now pretty generally believed that oil and natural gas are of organic origin, having originated by the accumulation and decay, chiefly of low orders of plants and possibly to a lesser extent of animal remains in sedimentary muds of either fresh water or marine origin.

It is also widely believed that the hydrocarbons so formed have later migrated from their source beds into the reservoir rock, where they have accumulated to form pools, which are often associated with arch-like structures of the beds.

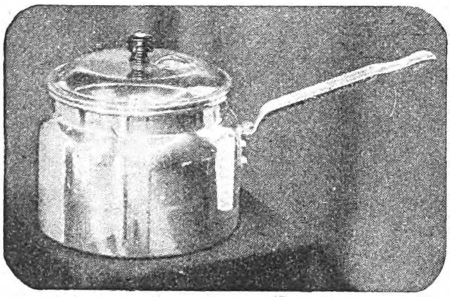
The rather wide geologic distribution of these oil pools in sedimentary rocks ranging from Ordovician to Tertiary in geologic age indicates that conditions favorable for oil formation recurred a number of times in the geologic past.

Inventions for the Household



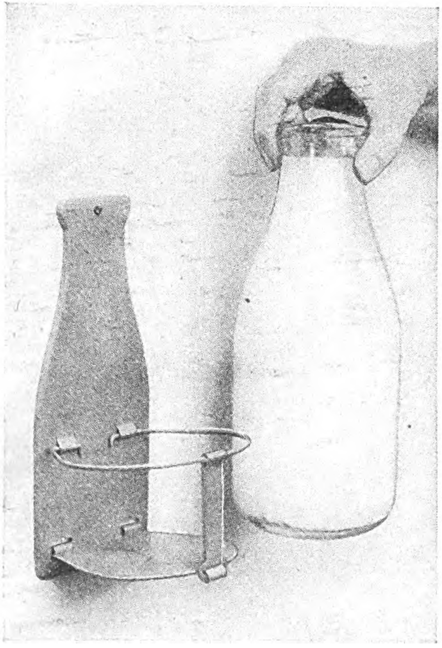
DRESS ENVELOPE

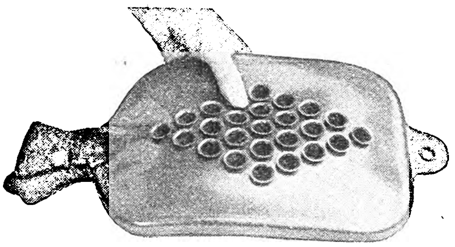
This covering for men's or women's garments preserves them when packed away, and also provides a hanger which can be used without disturbing the clothing within. Envelopes are equally useful at home or when traveling.—*General Appliance Corp., San Francisco, California*



EGG KETTLE

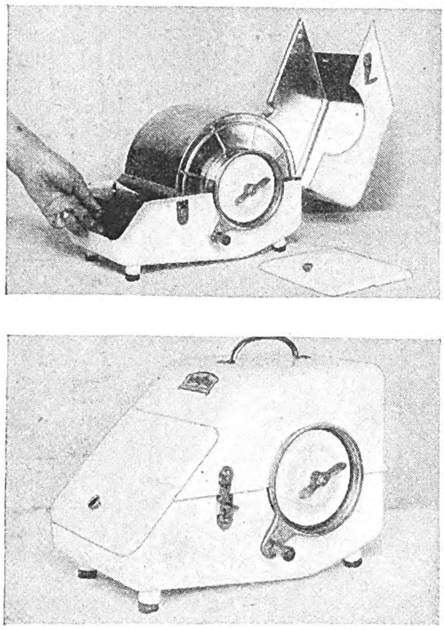
Put the eggs in this kettle, cover with cold water, put kettle on the fire, and go about getting the rest of the meal. When the whistle sounds, remove eggs. They are done right.—*The U. S. Manufacturing Company, 123 Clovelly Road, Stamford, Connecticut*





IT STAYS PUT

It is often found difficult to keep the ordinary hot-water bottle in place. This new type, however, is equipped with vacuum cups which hold it securely, regardless of position, and prevent it from slipping.—*Daniel E. Lutz Company, Buffalo, New York*



QUICK ICE CREAM

Ice and salt are placed in the cylinder. Liquid to be frozen is placed in the trough. As the cylinder is revolved, the liquid freezes on the outside of it, and the frozen delicacy is scraped off into a waiting tray.—*Instant Freezer Corporation, Racine, Wisconsin.*

BOTTLE HOLDER

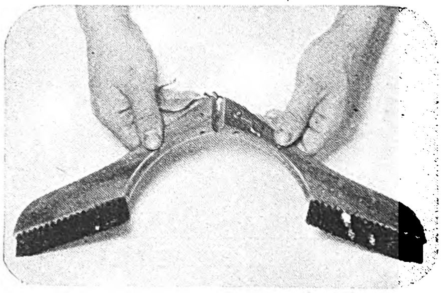
This milk bottle holder may be fastened wherever convenient. It folds out of the way when not in use. —*S. S. Kresge Company, Chicago*

BUG BARRIER >

When beds, refrigerators, et cetera, are equipped with these felt pads saturated with bug-repelling liquid and placed over the castors, they are kept free from insects.—*Wm. B. Ramsey, P. O. Box 487, Atlanta, Ga.*

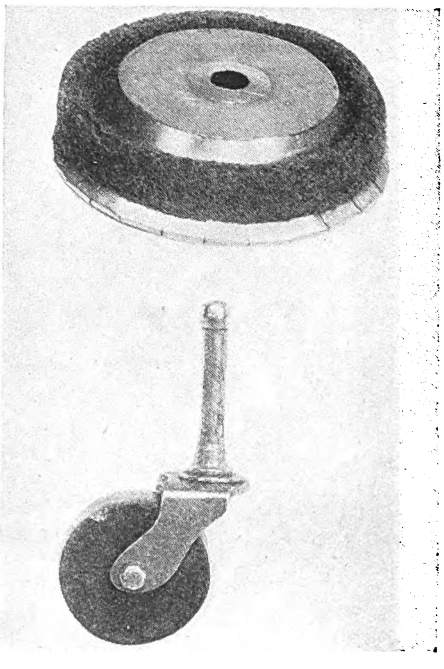
BATH SAFETY

Statistics show graphically how many people are injured by falls in bath tubs. This mat, held in place by vacuum cups, will tend to reduce this hazard, as it presents a firm, perfectly safe footing to wet, slippery feet.—*Safe-Bath Company, 4924 Sheridan Road, Chicago, Illinois*



HANGER-BRUSH

This folding clothes hanger serves two purposes. It is, first, a hanger, and second, an efficient clothes brush. The folding feature makes it desirable for traveling.—*Avery Manufacturing Company, 244 Long Lane, Tower Bridge Rd., London, SE1, Eng.*



The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

A Pleasure-Car Snow-Plow

MOTORISTS who live in suburban towns and have their garages located in alleys or at the ends of long driveways; on private lanes; or in the country, usually have much trouble, when winter comes, in clearing away the snow for more easily driving their cars. To these, a simple snow-plow that can be attached to their pleasure cars should be a boon. Such a plow has been invented and patented by Mr. E. B. Meyer of Newburgh, New York, whose father, strangely enough, years ago took out patents on a quickly detachable overshoe for horses, designed to prevent them from slipping on the ice.

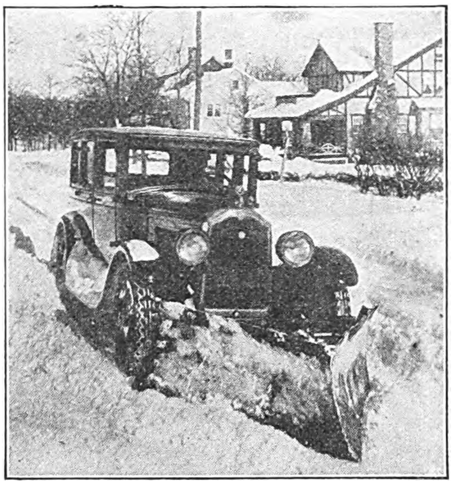
The plow is constructed of heavy gage sheet steel and weighs a little over 200 pounds. Most of the weight is carried on a specially-constructed self-steering runner which holds the plow off the ground. The whole device is attached to the car by means of axle clamps which remain on the car the year 'round. The plow is connected in a few minutes by inserting two hinge bolts and it is easily handled by one man.

Cage Experiment Proves Borer Can be Controlled

MORE than a million square feet of copper screening were used in the construction of two gigantic cages which experts of the United States Bureau of Entomology employed in a unique experiment to determine the effectiveness of methods recommended for controlling the destructive corn borer.

The cages were built under the supervision of Dr. W. H. Larrimer on a farm maintained by the bureau in a heavily infested region near Toledo, Ohio. Each cage was nine feet high and covered an acre of corn, planted after the soil had been treated to destroy the larvae.

As the moths appeared they collected on the top and sides of the cage, from which they were painstakingly gathered with butterfly nets. An actual count was made of the number which emerged and this count, which has just been completed, reveals that control methods developed by the bureau are more than 98 percent effective. As a result, the Department of Agriculture will redouble its efforts to persuade farmers to use these methods in the American corn belt.



The 200-pound snow plow which is easily attached to a passenger car

From 25 to 40 percent of each season's corn crop is frequently destroyed in regions infested by this dangerous pest, which, since its discovery near Boston in 1917, has spread over approximately 100,000 acres of corn country. In Ontario, Canada, destruction has reached a record high of between 75 and 80 percent of the crop.

Entomologists are convinced that it will be impossible to eradicate the corn borer but the recent experiment indicates that it can be controlled sufficiently to reduce commercial losses to a negligible amount. Plowing under infested stalks and stubble so that no plant remnants, harboring the worms, remain on the soil surface, is an effective control. Burning over the fields is another effective mode of combat. Special burning machines, which use oil as fuel and produce heat and flames reaching a temperature of 1400 degrees, Fahrenheit, have been developed for this purpose.

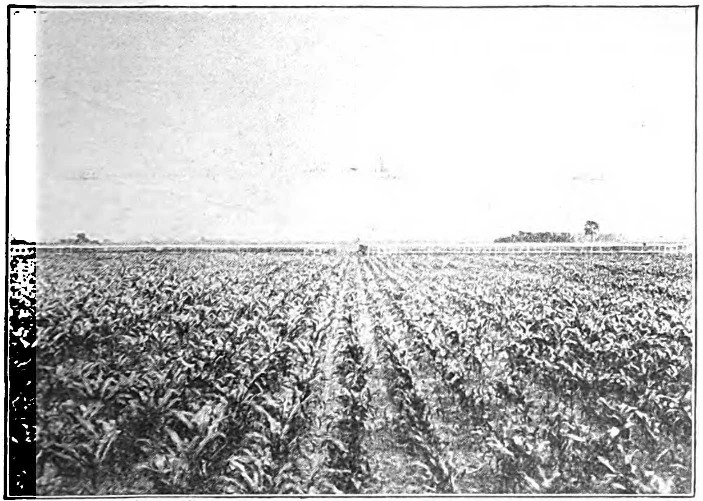
—*Science Service.*

Metering a Car's Behavior

MEASURING the pulling power of an automobile by the swing of a magnetically balanced pendulum is now possible with a device called the performance meter. The makers of this self-contained instrument offer it as a means of accurately rating the pounds-pull of a new or used car, of determining the car's percentage of efficiency, and of checking loss of power due to excessive carbon in the motor, frictional losses, or improper carburetion.

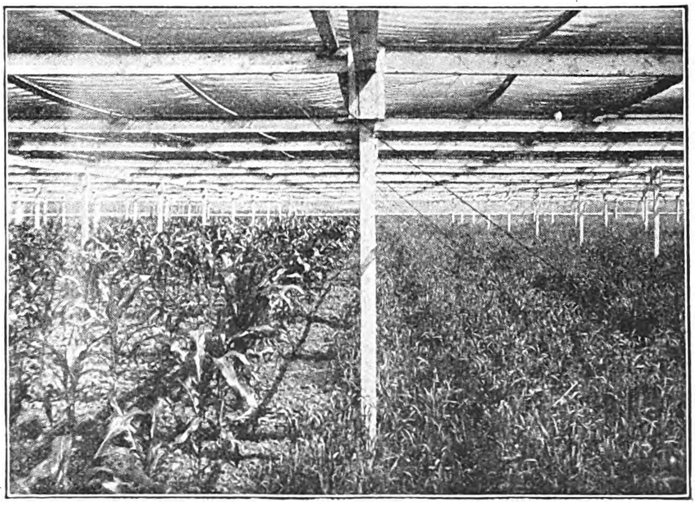
The pendulum consists of a powerful permanent magnet suspended to take a normally vertical position. It thus utilizes the principle of the plumb bob, but is controlled by a damping fluid in a hermetically sealed box. With this control it achieves sufficient stability to resist jars and sudden shocks that would make its movements erratic.

The meter is solidly and attractively built and equipped with a universal connection for mounting at any angle on the dash or the steering post of a car. In either of these positions, the scale on the periphery of the rotating element is visible to the driver. On the left side of this element the scale is marked in pounds-per-ton pull, while the other is marked in percentage gradient. It may be used for determing the acceleration or deceleration of a car, may be made to show friction and power losses of the motor, and to determine



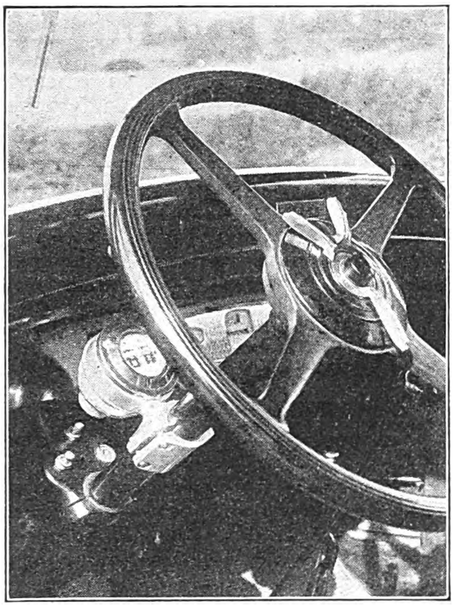
Courtesy Bureau of Entomology

The two cages, seen in the distance, which were built to determine the effectiveness of methods of control of corn borer. The ground covered was previously treated



Under the protection of one of the acre-large cages, where moths were caught as fast as they grew to maturity and compared with those from untreated ground the steepness of a grade on which a car is running.

In determining the maximum pulling power of a car, the meter is adjusted by means of a worm screw to a zero reading. Then the car is driven up any hill sufficiently steep to give low speed in high gear. The maximum pounds-per-ton pull is then read on the meter just before a change of gear is necessary. This gives a definite standard of rating on which to compare the performance of your car later.



Installed on steering column, the performance meter is always visible

The maximum pounds-pull is usually shown at a speed of about 20 miles per hour, and it is often more convenient to use the pulling power of a car at 30 miles per hour as a basis of comparison. This may be obtained by driving the car on a slight up-grade at about 10 miles per hour and then depressing the accelerator fully. Maximum acceleration may then be read directly from the meter some time before the car reaches a speed of 30 miles per hour. Acceleration, while the carburetor, timing gears, or other parts of the motor are being adjusted, compared with the original maximum reading, will show a variation from normal and indicate perfect adjustment or the necessity for further adjustment.

In using the gradient scale, the meter, of course, must be set at zero while the car is standing. Then when the car is driven up a hill at constant speed, the percentage of grade may be read directly from the meter.

This performance meter which has been called the physician of the motor car since it will diagnose common motor troubles, is an English product and is being introduced in this country by E. C. Cheswell of Melrose Highlands, Massachusetts.

Machine Gun and Crew Dropped from Airplane by Parachute

According to a report emanating from the War Department, airplanes have found a new field of usefulness. The report states that, in a demonstration at Brooks Field, Texas, recently, machine gunners together with their gun, dropped from an airplane and, on landing, went into action in less than three minutes.

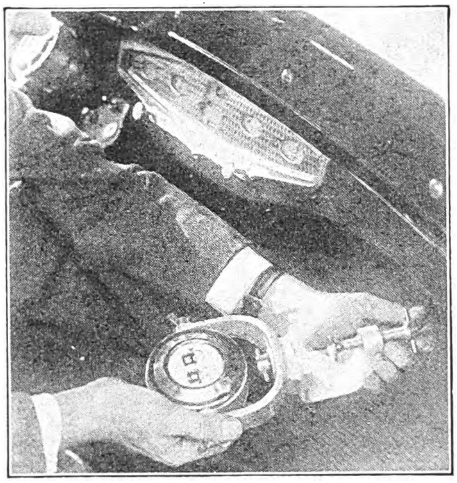
In the demonstration, six men jumped from a bombing plane, each with his individual parachute, picked up the machine gun which had also been dropped on a parachute, set it up, and started firing.

In this manner it is possible that a number of guns and their crews could be dropped and placed in action in commanding positions. The value of this maneuver in warfare would lie in the large element of surprise it contains. Its strategic value may prove to be very great.

Self Lubricating Spring

Motorists and automotive engineers have long been seeking to improve the method of lubricating springs. Because of the comparative inaccessibility of automobile springs, they are frequently neglected. Dust, dirt, and water work into the springs, making frequent and efficient lubrication necessary if the springs are to be kept from being virtually welded together, nullifying the advantage of laminated spring construction.

New springs ride easily because they are greased with graphite before they are assembled. But when the lubricant dries out, the springs rust and lose their flexibility, eventually crystalizing to such a degree that any severe jolt may break them.



Another type of mounting for the performance meter, for installation on the dash of an automobile

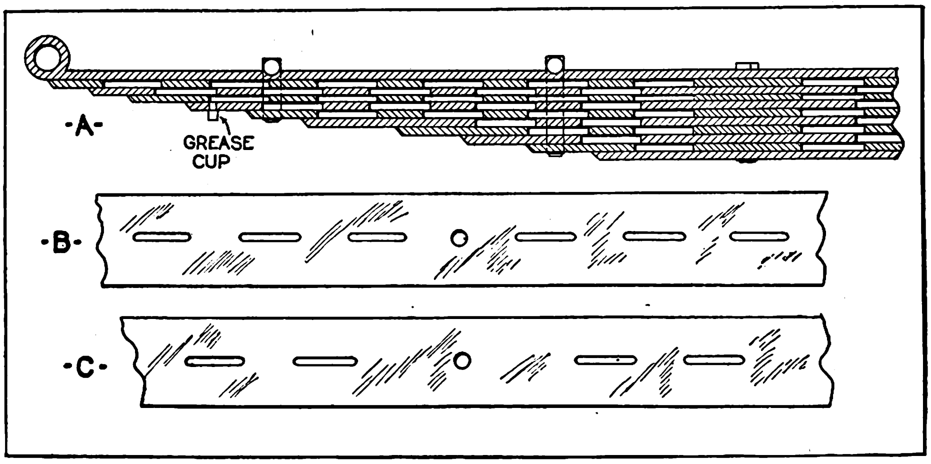
To counteract this tendency and to make the necessary lubrication so easy that there will be no cause for neglecting the springs, a self-lubricating spring has been designed by the Triple Action Spring Company.

Slots one quarter of an inch wide and two inches long, overlapping one quarter of an inch with slots in adjacent leaves, provide a channel for the grease to be distributed across the face of each leaf by capillary attraction and the flexing of the leaves.

By means of Dot, Zerk, or Alemite grease cups, each end of the spring can easily be filled with grease. In this way sufficient grease is provided completely to lubricate the leaves for approximately 1000 miles.

Tests made by the designer of the self-lubricating spring showed that old springs drilled with overlapping grease slots and filled with an ordinary grease gun, not only produced greater flexibility and freedom from squeaks but also materially increased the mileage received from a set of tires. Cushioning the spring leaves with grease also saves motor and chassis from a certain amount of devastating vibration.

The self-lubricating springs are made in sizes to fit any make or type of car, and are reinforced. By drilling the standardized slots in the leaves, old springs that are still in good condition can be made self lubricating.



Self-lubricating spring. The spring leaves are pierced with slots at intervals, slots of adjacent leaves overlapping as shown in sections A and B-C

Physiological Experiments Make Vehical Tunnels Possible

How modern tunnels for vehicles under rivers, such as the Holland Tunnel under the Hudson, have been made possible by means of experiments on animals and experiments in which full-sized autos were driven through a small experimental tunnel, is revealed in a report to the Engineering Foundation in New York by A. C. Fieldner, chief engineer of the experiment station division of the United States Bureau of Mines.

When the Holland Tunnel was first proposed, says Mr. Fieldner, many engineers thought that it would be impossible to ventilate. The amount of poisonous carbon monoxide given off in the exhaust was thought to be so great that it could not be carried away.

Experiments made by Professor Yandell Henderson at Yale University showed that as much carbon monoxide in the air as four parts in 10,000 would not be harmful if the exposure did not exceed an hour. The first experiments were made on animals, then Professor Henderson and his students tried it on themselves.

Then an experimental tunnel was built at the experimental mine of the Bureau of Mines near Pittsburgh. This was nine feet wide, eight feet high, and 400 feet long. Above the ceiling was an air duct three feet high, and below the floor was one two and one half feet high. Either could be used for introducing fresh air or for exhausting contaminated air.

Small automobiles were driven back and forth through the tunnel at a speed of 10 miles an hour, and at 40-foot intervals. Tests were made with various methods of removing and admitting the air, and examinations of the drivers by blood tests were made before and after. It was found that the most efficient method of ventilating was to admit the fresh air at the bottom and to remove it at the top.

Another safety device developed by the Bureau of Mines which is in use in the Holland Tunnel is an automatic carbon monoxide recording machine, which rings a bell and flashes a danger light when the gas becomes more concentrated than four parts in 10,000. Then immediate steps can be taken to increase the circulation of air.—*Science Service.*

Correction—Byrd's Coffee

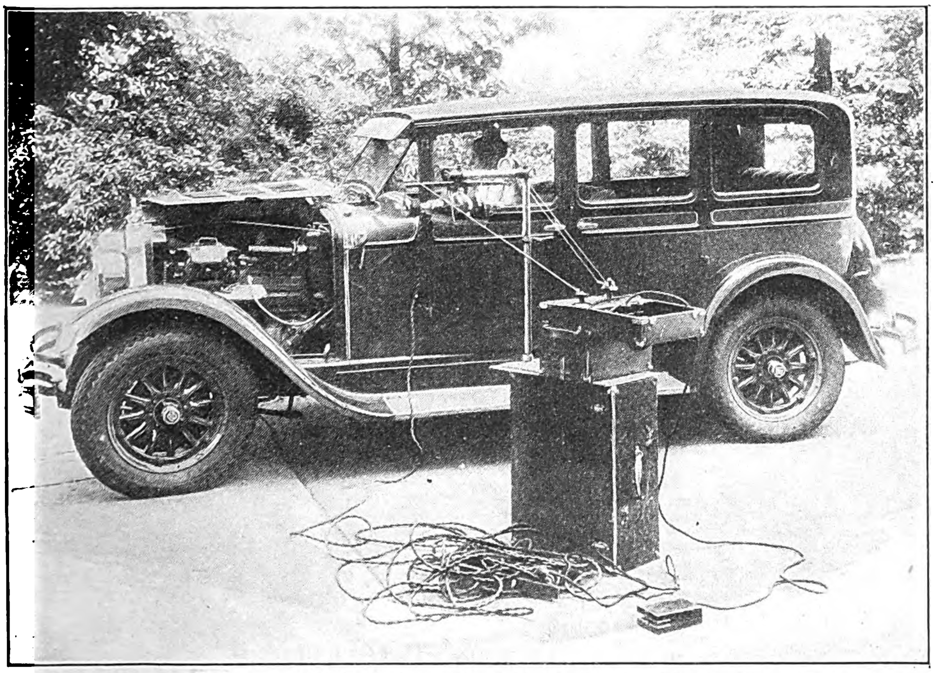
IN our November issue, under the title "Stocking Up An Expedition's Larders," an error was made in telling of the coffee to be used on the Byrd antarctic expedition. The coffee taken on board the ships was the well-known Bokar, supplied by The Great Atlantic and Pacific Tea Company, Inc.

Doctor Equips Car With Portable X-Ray Set

IT is generally conceded that "if the mountain can't come to Mohammed, Mohammed must go to the mountain." But if Mohammed chanced to be urgently in need of an X-ray diagnosis, and unable to go to the hospital to have his interior photographed, it is quite likely that he would dictate a note to Dr. C. B. Moses of Buffalo, New York, requesting the doctor to call at once with his portable X-ray equipment.

Dr. Moses has attached a generator to the cylinder block of his Dodge sedan, and the motor supplies the power. Permanent wiring leads from the generator to a socket on the dash board of the car, where he can plug in a flexible cord of sufficient length to permit operation of the X-ray machine in the patient's room. We have been informed that the idea of equipping a motor car with a portable X-ray outfit is original with Dr. Moses and that this is the third car of this make which he has so equipped.

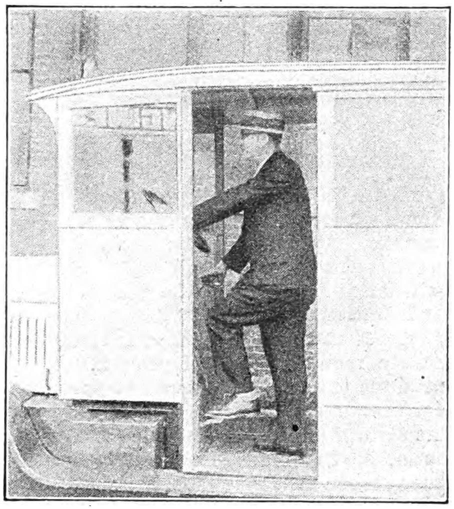
The complete equipment is carried in a case no larger than a steamer trunk. Dr. Moses is a member of the staff of the Deaconess Hospital of Buffalo.



The portable X-ray outfit built by a Buffalo doctor on his Dodge sedan, the motor of which drives a generator which, in turn, supplies the power

Stand-Up Drive Milk Delivery Car

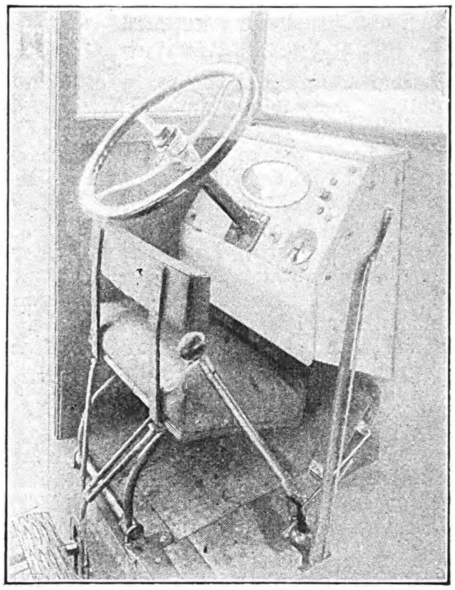
A NEW type of delivery truck especially designed to serve house-to-house routes has appeared on the automotive scene. It is claimed that this new vehicle, made by the Step-N-Drive Truck Corporation of Buffalo, New York, combines the advantages of the old horse and wagon days and those of the modern motorized deliveries.



Entrance to the stand-up drive truck may be from either side, the floor being on a level with the axles

The outstanding feature of the new truck is its drop frame construction enabling the operators to drive either in a standing or sitting position. As the truck body is open throughout, the driver is able to work his load from the front seat, thus obviating the necessity of a trip to the back of the truck to get the orders which are to be delivered.

The driver of one of the new trucks may sit down while driving to his first call in the morning. As he leaves his truck for his first call he can fold the seat up under the steering wheel and thereafter make his house-to-house calls driving in a standing position. The truck is so constructed that the driver can enter from either side.



Driver's position in the stand-up drive delivery truck. Note folding seat, and clutch in left corner

While driving, the driver is protected from the weather and is wholly inside the truck.

Driving in a standing position is accomplished by using a combination foot brake and clutch pedal. Partly pushed in, the single pedal acts as a clutch; fully pushed down it acts as a foot brake. Regular pedals are used for driving while seated and the steering wheel has been angled so that it is in a comfortable position for handling either standing or seated.

In addition to the usual foot accelerator, there is a hand accelerator on the gear shift lever for regulating the speed while driving in a standing position. There are also the usual gas and spark levers on the steering wheel.

The truck is insulated at the sides, dash, and floor; and the motor is completely insulated from the body, allowing no heat, dirt, or odor to come into contact with the contents of the truck.

It is claimed that these trucks effect an economy of 40 percent over the old horse and wagon, and 25 percent over the standard type trucks.

Novel Heating System for New British Embassy

THE new British Embassy being constructed here will contain a new heating system which eliminates all radiators. The rooms are heated by small hot water pipes buried in the walls, ceilings, and floor.

The system is in use in England but never before has been installed in an entire building in this country.

In some of the rooms the entire walls and ceilings will be heated by the pipes, and in

others the floors will be warmed. This system was finally decided upon by the British officials in order to do away with all visible radiators and other heating devices.
—*Science Service.*

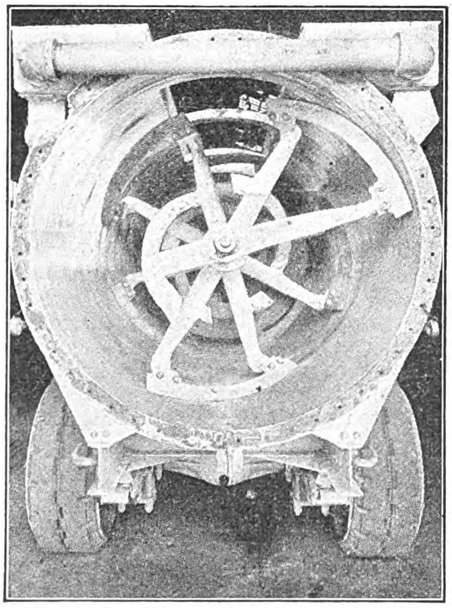
Use Aluminum Cans for Food Preservation

THE up-to-date housewife has for some time appreciated the value of aluminum for the cooking and preparation of foods, and now the commercial canners are beginning to realize that aluminum may turn out to be the ideal material for the manufacture of containers for canned foodstuffs.

Dr. H. Serger, a German investigator, has already obtained encouraging results on this point. He has found that aluminum is much less attacked by fruit acids than is the tin of the usual tinned iron cans.
—*Science Service.*

Smashing Atoms Costly Business

THE unlocking of vast stores of atomic energy must remain a 20th Century alchemists' dream for a while, if results of researches at the Physico-Technical Institute of Germany are substantiated. It requires too much bombardment to crack an atom.



Interior of the concrete mixer-carrier truck showing rotating arms

According to quantitative measurements made at the Institute, the demolition of a single atom of aluminum or magnesium requires on an average 1,000,000 alpha particles, or free electrons. For the destruction of one boron atom, 100,000 alpha particles suffice.—*Science Service.*

Concrete Mixer-Carrier Truck

IN concrete construction work, the tendency in recent years has been to some extent toward transportation of pre-mixed concrete from a central mixing plant. The belief is that specialists in concrete mixing can more easily maintain standard mixes according to specific formulae than can the contractor on the job who must depend on more or less inexperienced labor. The greatest drawback to this practice, however, is that unless the mix is constantly agitated, it will set rapidly in the transporting vehicle. Various methods of overcoming this have been developed and some of them have been very successful.

In San Francisco, the American Truck Mixers Company has solved the problem by developing a concrete carrying truck which not only agitates the mix while it is being carried to the job, but actually mixes the concrete. The mixer consists of a large tank mounted on a heavy truck. The mixing element, a large shaft passing through the center of the tank and equipped with arms connected in worm-screw fashion, is geared to the motor. The cylindrical tank does not revolve.

At a central plant, the gravel, sand, cement, and water are poured, in proper proportions, into the top of the tank. The ports are then closed and, as the truck proceeds to the job, the concrete is thoroughly mixed and kept in a state of constant agitation until discharged.

Vitamin B Split Into Three Parts

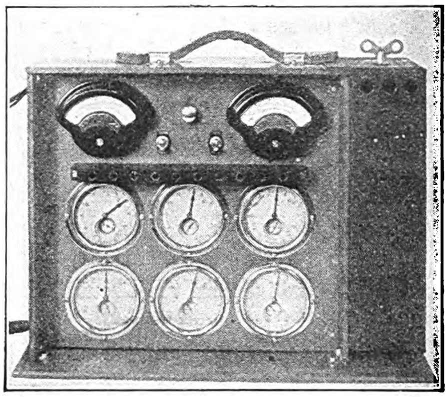
VITAMIN B is really triplets. The well-known food factor has been separated into three parts, each of which has different effects, according to a report by Charles H. Hunt of the Ohio Agricultural Station.

Two of the vitamins when fed together cause a moderate rate of growth. When fed alone each of these two causes only a slight increase in growth for a short time. The third, found in the residue from which the other two had first been separated, causes, when used alone, only slight growth for a short period, after which there is a decline. When this vitamin is added to the two others the excellent growth associated with the original vitamin B results.

Further tests showed that this third vitamin has all the characteristics of a vitamin in addition to being able to stimulate the other two so that they cause greater growth than when used alone.—*Science Service.*

Device Measures Automobile Jolts and Jars

ENGINEERS are constantly seeking to design automobiles that will ride more smoothly and comfortably, but so many road and car factors enter into the problem, and the sense of comfort of different passengers varies so greatly, that a more accurate method is needed to determine the riding qualities of a car than that of merely traveling in it over good, bad, or indifferent roads.



Portable meter box, a part of the equipment for measuring car jolts

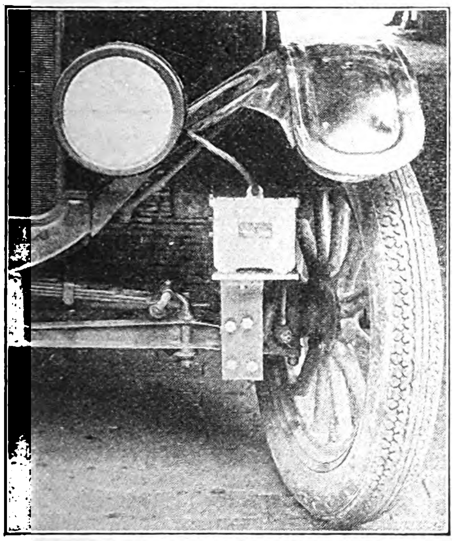
Numerous devices called accelerometers have been developed for the purpose of measuring and recording the jolts and vibrations to which a motor vehicle is subjected. The most recent of these is an electrical instrument developed by R. W. Brown, head of the engineering laboratory of the Firestone Tire and Rubber Company.

Because of its relatively small size and connection with the vibration counter through electric wires, this accelerometer can be mounted on any part of the vehicle, so that a record can be made of the vibrations at any place. Thus the action of the tires, axles, springs, body, and seats can be studied separately.

By using separate accelerometers located in various positions, the riding qualities of

The concrete truck which mixes a batch of concrete while transporting it to the point of discharge. The mix is kept agitated by a churning action any individual portion of the vehicle can be segregated, all records being made at the same time and on the same piece of road. With such records the engineer can proceed to work out the characteristics needed for the improvement of each part.

The new instrument contains a series of small weights normally held up against contact points by magnetism from an iron-clad solenoid. An upward force breaks the contact and the weights move downward against light springs, which also serve as lower contacts. By means of adjusting screws, each of the weights can be set accurately for a given force of acceleration, and by varying the electric current a wide range of forces can be measured.


Automobile vibration recorder which may be attached to any part of a car

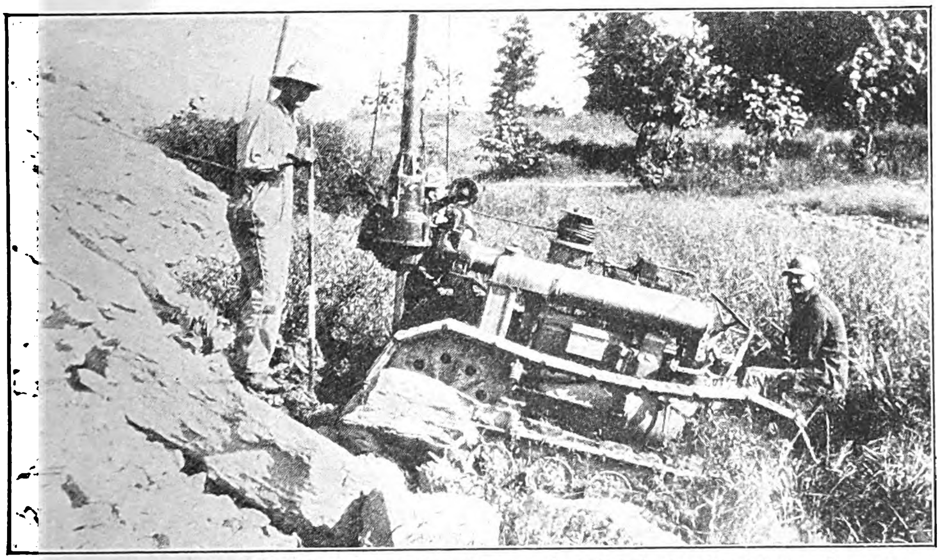
So sensitive is the new instrument that it records variation of as little as five pounds in the air pressure in the tires.

Tractor Earth Boring, Pole Setting Machine

IN line construction and maintenance work, public utilities are often faced with many difficulties presented by hilly and rocky terrain, and the fact that the work must be done at great distances from highways. A new machine developed by the Highway Trailer Company, of Edgerton, Wisconsin, since it is mounted on a Fordson crawler tractor is capable of negotiating practically any sort of ground, bores holes for telegraph poles, and finally sets the poles. It is claimed that an average of a pole in the ground every five and one half minutes is being done in actual construction work at this time.

The boring unit of this machine is mounted in front and is capable of handling augers from eight inches up to 24 inches in diameter, the latter under favorable conditions. The multiple disk clutch of the boring unit as well as gears in the intermediate boring case operate in a bath of oil. Besides boring holes for poles, this boring unit will also dig at any angle necessary for all types of anchors.

Mounted on top of the machine is a 2500 pound capstan which is operated by the driver and from which the cable passes to a pulley at the base of the pole derrick, then to the top sheave. By operating this capstan, a pole up to 45 feet long may easily be lifted into place with the assistance of only one or two men to balance it properly. The whole derrick rises from 14 to 18 feet above the ground in a working position, but is dropped to a height of about eight feet for road travel.


The new machine which bores holes for, and sets telegraph poles. It can negotiate rough ground and will bore holes vertically or at an angle

Photographs Show Airplane Altitude

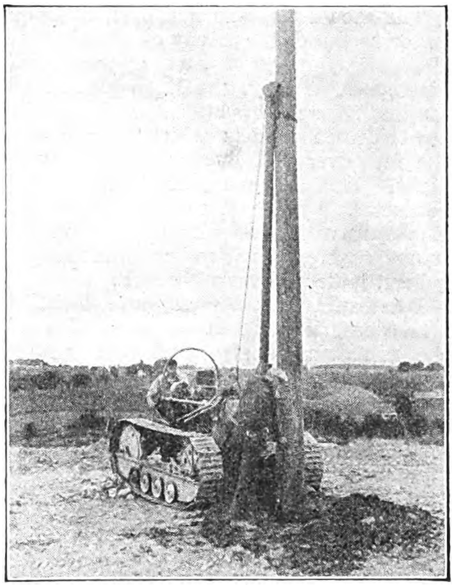
A NEW method of determining the altitude of airplanes above the ground is forecast as the result of photographs made on a recent record-breaking flight of the Army Air Corps. The flight was made by Captain St. Clair Street, accompanied by Captain Albert W. Stevens as observer and photographer. Although the Bureau of Standards has not yet checked up on their altitude, they are believed to have reached 40,200 feet, at which height they made photographs of the city of Dayton, Ohio. This altitude is higher than the present record for a plane with one man, two men, or photographic equipment.

Despite a scattering of clouds at 6000 feet, the photographs show the highways and outstanding structural characteristics of the territory below with remarkable clarity. So distinct are the pictures, in fact, that they could stand enlargement to 10 diameters. The high-altitude photographs taken by Captain Stevens offer a new method of obtaining altitude measurements. If three or more points on the ground are shown, the distances between which are known from accurate ground survey data, then by measuring the distance of the image separations on the negative and knowing the distance from the negative to the optical center of the lens in the camera, the problem of the length of the perpendicular dropped from the lens to the ground becomes a geometric one of similar triangle, and can be figured in feet or meters to within one tenth of 1 percent mathematical accuracy. Comparison of the results thus obtained with those gained from the barograph formula method employed by the statisticians, will undoubtedly prove both interesting and important.—*Science Service.*

Architect Wanted Tomb Like Queen's

THE strange story of Senmut, an Egyptian architect who wanted a kingly burial, is pieced together following the latest excavations at Thebes made by the Metropolitan Museum's Egyptian Expedition. (Refer to page 37 of this issue for other details.)

While digging around the ruins of a temple which Senmut built for the famous Egyptian Queen Hatshepsut, the expedition discovered steps leading down deep into the ground, H. E. Winlock reports. Here, 100 yards below the surface, was found the unfinished secret tomb which the architect was building for himself while he worked on the queen's temple.


Setting a pole with one man's help by means of the derrick and capstan

Senmut stood so high in the favor of Queen Hatshepsut that he bore the high-sounding titles of Chief Guardian of the King's Daughter, High Steward of the Royal Household, Superintendent of the Royal Slaves, and Superintendent of the Royal Bedrooms. But this commoner yearned for permanent records of his close association with royalty.

Two years ago, this ambition was revealed when the expedition discovered that Senmut had ordered his own portrait introduced behind every door in the temple he was building.

"And now," says Mr. Winlock, "this past season we find him tunneling right under the temple enclosure to make a tomb for himself suggestively like Hatshepsut's."

(*Please turn to page* 88)

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York City

Model Aircraft

WE have recently received two books on model aircraft construction which were somewhat of a revelation to us. One is entitled "Building and Flying Model Aircraft" by Paul Edward Garber (Ronald Press, New York City); the other is "Beginning to Fly" by Merrill Hamburg (Houghton Mifflin Company, Boston and New York). Both are excellently written, by evident masters of the art of model construction, and a prospective purchaser would find it hard to choose between the two. Anyone seriously interested in the art would probably find it worth while to secure both volumes, or consult them at a public library.

The model airplane has been a serious factor in the development of the airplane. The great pioneers of the early part of the nineteenth century, the Englishmen Henson and Stringfellow built most interesting power-driven models which were indeed the first ever to make a heavier-than-air flight. One of Stringfellow's models was 10 feet in span and two feet in chord. Equipped with a very light single-cylinder steam engine, and two gear driven propellers, it flew remarkably well.

Dr. Langley used many models in his researches, at first using rubber drive with the rubber both stretched and twisted. Subsequently he constructed a large model, 14 feet in span and powered with a one horsepower steam engine. This model, launched from a catapult, weighed 26 pounds and made a flight of three quarters of a mile. His last model was powered with a 3.2 horsepower gasoline engine and constituted an exact quarter-size duplicate of the full-sized Langley "aerodrome" which failed in its trial of December 1903, due to launching difficulties, but is nevertheless considered by many authorities to have been capable of real flight.

In the scientific work of to-day the model still plays an important part. In wind tunnel work exact scale models of aircraft are made, often to an accuracy of 1/200th of an inch, subjected to a steady air stream in the tunnel and used to determine the characteristics of efficiency and stability of an airplane in process of development. Some few years back, certain army and navy airplanes developed a curious "flat spin." In this condition the airplane would remain at a very large angle of incidence and spin around and around a vertical axis while dropping fairly slowly to the ground. The most powerful efforts of the pilot would fail to restore a normal attitude.

Plane after plane would land in this maneuver, fortunately with no injury to the pilot because the rate of descent was so slow. The mathematics and aerodynamics of the flat spin were so intricate that a final understanding of the phenomenon was arrived at only by the use of models, launched in a spinning attitude from a height of 100 feet or so, and either caught in a net or kept from damage by the use of an automatically released parachute.

The solution of the mystery was that the plane in a flat spin acted like a gyroscope, and therefore resisted any change in its plane of rotation. The flat spin can be avoided by more powerful controls and by such a distribution of the mass of the airplane that the moments of inertia about the three axes of the airplane are not too greatly different in amount.

Model aircraft are of utility moreover in making the youth of the United States airminded, and perhaps in awakening inventive and design genius. Grover C. Loening, Clarence D. Chamberlin, and many other well known experts in the field of aviation owe their start to model aeronautics.

Reading these two small books, one is amazed at the variety and extent of the model aircraft work which is available for boys generally and for manual training classes particularly. With a rubber driven model, Robert V. Juros, in 1924, while a student in a western college, made the astounding record of 7920 feet and a duration of 10 minutes 14.2 seconds. This record has never been surpassed.

Model gliders are simplicity themselves and serve as a useful introduction to the finer points of the model game.

The interest of flying a kite can be enhanced by using a model parachute. The parachute is hooked by a ring to a wooden traveler, with a screw-eye and wire release. When this is placed on the kite line, the wind seizes the 'chute and carries it and the traveler aloft to the kite, where the wire release hits a button and the 'chute is released. As the traveler comes back down the line like an express train, it is better to stop it with a heavy stick rather than with the hands, so as avoid injury.

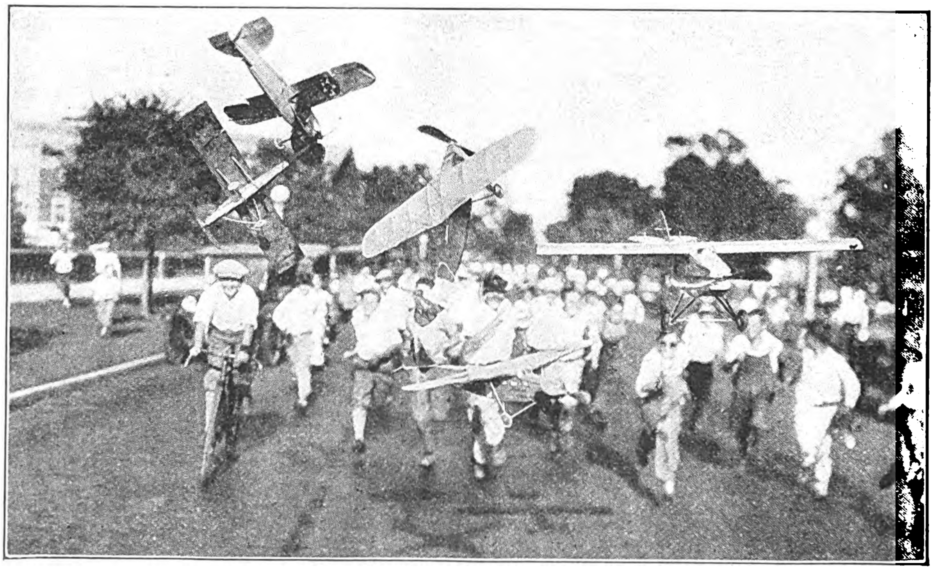
Another method of releasing a parachute from a kite is to attach it to the kite, before ascension, with a piece of "punk" which in turn is lighted and tied to the kite. The kite is then flown with the 'chute attached, but when the punk burns down to where the string is tied the chute is released. The slow and graceful descent of a parachute from a high flying kite, as described by Mr. Garber, is a pretty sight and adds greatly to the thrill of kite-flying.

Mr. Garber also describes the very interesting process of building and flying model balloons, and gives explicit instructions for the building of compressed-air motors. The use of compressed air seems to be a most promising method of flying power-driven models, although gasoline engines are now also being used successfully.

Aviation in Central America

AIRWAY AGE summarizes the plans of Pan American Airways in a recent issue. Under contracts already awarded by the Post Office Department, the company will operate air routes 4023 miles in length and extending through 12 different countries. The company is now carrying passengers from Miami to Havana and return daily. Very shortly it will inaugurate three round trips a week between Miami and Porto Rico. The net work of air lines which is sketched out on our map is in active preparation, and airports are being built at Camaguey, Cuba; Santiago, Cuba; Port au Prince, Haiti; Santo Domingo, Dominican Republic; and San Juan, Porto Rico.

The flying equipment will consist of large



An unusual action photograph of model airplanes in the air three-engined planes, for which negotiations are being made with the Atlantic Aircraft Corporation and the Sikorsky Manufacturing Company. Loening Amphibians will be used for special services.

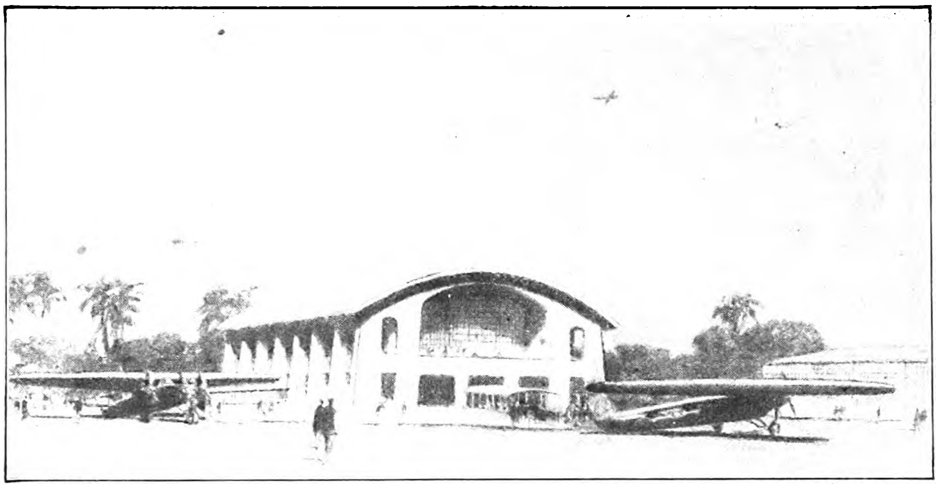
Careful attention is also being given to traffic arrangements with railways on the Atlantic seaboard, travel bureaus and the new consolidated aviation ticket office. Traveling by way of the Atlantic Coast Line Railroad and the Florida East Coast Railway a passenger is now able to leave New York City in the evening and be in Havana on the morning of the second day.

The Miami terminal of the Pan American Airways, which represents the operating headquarters of the company, will be one of the best equipped airports in the world. It will include a passenger station, hangars, and machine shops, as well as headquarters for customs and immigration officials.

It has long been predicted that instead of the well constructed but rudimentary hangars of to-day, architects would step in and design air terminals as well arranged and as sound architecturally as some of our great railroad terminals.

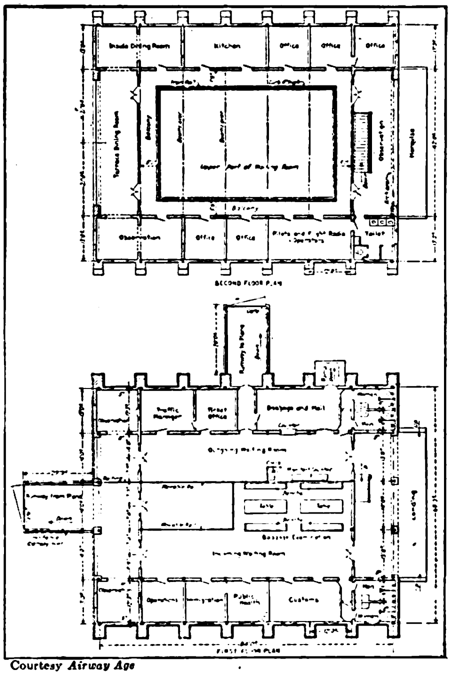
The passenger station at Miami has been designed by Delano and Aldrich, one of the outstanding firms of architects of the day. The terminal will include a reception room for visitors, and a spacious waiting room. A restaurant on the grounds will be provided with terraces arranged so that a clear view can be had of the movement of the airliners. A mezzanine balcony will be available for social functions.

Pan American Airways is controlled by the Aviation Corporation of America, which includes on its board of directors eminent bankers, operators, and business men. There is no doubt that the company will establish the United States very firmly in Central American aviation.



Courtesy Airway Age

An artist's conception of the terminal of the Pan American Airways at Miami, Florida. This is a two-story building, floor plans appearing directly below



Courtesy Airway Age

Floor plans of the Pan American Airway terminal. Notice how every desire of the potential air traveler is adequately provided for

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The Hazard of Lightning

PROFESSOR ALEXANDER McADIE, writing in a bulletin of the Daniel Guggenheim Fund for the Promotion of Aeronautics, gives an interesting summary of our knowledge of lightning. From the weight and fusion energy of a number of kite wires destroyed by an electric discharge he computes the instantaneous energy of one discharge to be of the magnitude of 7.5 kilowatt-hours. In some cases Professor McAdie estimates the voltage to be 50,000,000.

At any rate, an intense lightning flash can splinter struts, fuse the bracing wires, tear the fabric off a plane and kill the aviator. There is a double danger, first from the lightning and second from the existence of wind gusts, vertical as well as horizontal, which make it very difficult for even a skilful flier to control his plane. The catastrophe of the *Shenandoah* may illustrate the latter danger. It was apparently not the lightning but the up and down gusts of the air which brought disaster.

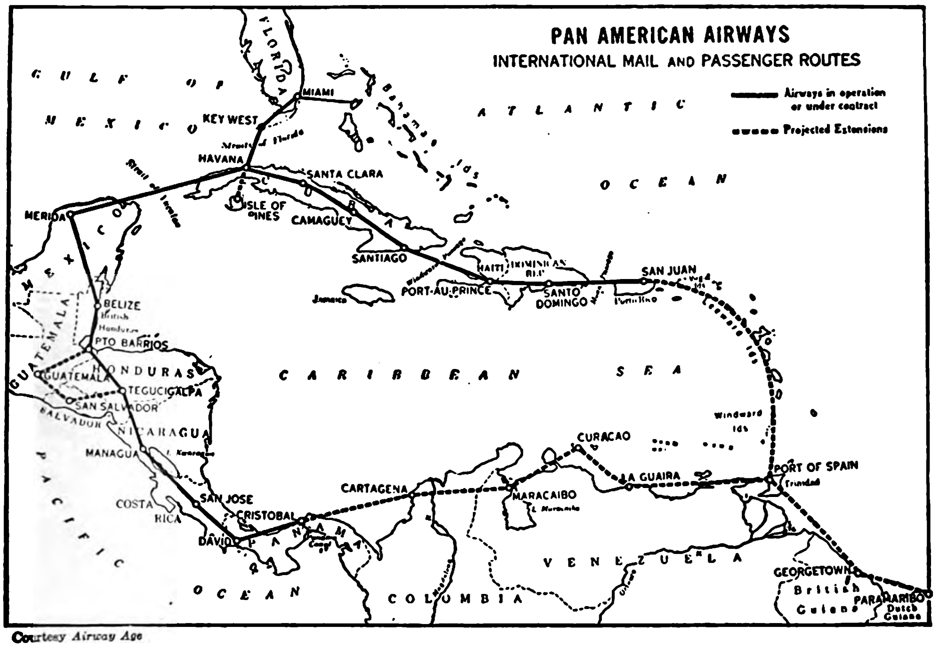
Airmen should keep a vigilant lookout for thunder clouds (cumulo-nimbus as the meteorologist calls them) and steer a course away or around them. It should be also possible in many cases to fly above the thunder cloud for many of them are below 10,000 feet. Professor McAdie predicts that there will be installed at airports, apparatus whereby the potential gradients of the air can be determined and approximate electric field strengths given. It may be also possible to invent apparatus which will automatically warn the pilot of the approach of dangerously charged clouds.

Aviation in the Schools

THERE are now quite a number of universities offering complete courses of instruction for aeronautical engineers, including highly technical training. There is the usual engineering foundation of advanced mathematics, applied mechanics, theory of heat engines and so on. This is followed by specialized work in aerodynamics, theory and design of the airplane, theory and design of the aircraft engine, propeller design, structural analysis and other subjects of vital interest to the airplane constructor of the future.

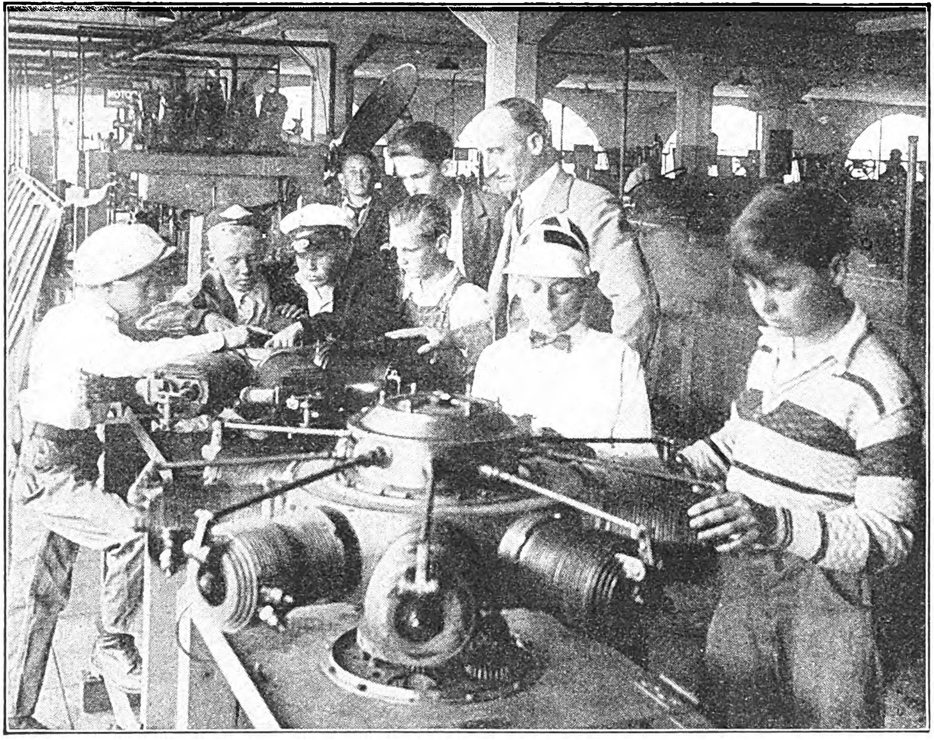
It may be said that the advanced instruction of the aeronautical engineer is now well taken care of, and offers no anxiety to either educators or industry, but there is another educational problem in aeronautics which yet remains unsolved: the introduction of aeronautics into the high schools of the country. A special committee has been appointed by the Daniel Guggenheim Fund for the study of this problem.

Since even to-day not every high school


PAN AMERICAN AIRWAYS
INTERNATIONAL MAIL AND PASSENGER ROUTES
Airways in operation or under contract
Projected Extensions
GULF OF MEXICO
FLORIDA
MIAMI
KEY WEST
Straits of Florida
HAVANA
ATLANTIC OCEAN
SANTA CLARA
ISLE OF PINES
CAMAGUEY
MERIDA
MEXICO
SANTIAGO
HAITI
DOMINICAN REP
SAN JUAN
PORT-AU-PRINCE
SANTO DOMINGO
Jamaica
BELIZE
British Honduras
PTO BARRIOS
GUATEMALA
HONDURAS
TEGUCIGALPA
SAN SALVADOR
SALVADOR
NICARAGUA
MANAGUA
CARIBBEAN SEA
Windward Is
CURACAO
LA GUAIRA
PORT OF SPAIN
Trinidad
CARTAGENA
MARACAIBO
SAN JOSE
COSTA RICA
CRISTOBAL
PANAMA
DAVID
PACIFIC OCEAN
COLOMBIA
VENEZUELA
GEORGETOWN
British Guiana
PARAMARIBO
Dutch Guiana

Courtesy Airway Age

Map of the routes of the Pan American Airways. See text and other illustrations



Instilling air-mindedness in the youthful scholar. In this illustration boys are busily engaged in the study of an air-cooled engine of conventional design

boy is going to enter college, how far should the high school attempt instruction in aeronautics for a boy who is not proceeding to college? Should the high school, and in particular the technical high school, attempt to give him the elements of aerodynamics and airplane theory, teach him airplane drafting, airplane assembly and rigging, and the care of the aircraft engine? Is there not a danger that such specialized work may displace from the boy's curriculum fundamental subjects of a more general character which will better fit him for the unexpected exigencies of industrial life?

It is interesting to learn that a number of schools, more especially in the west, are attempting such instruction. In Los Angeles, in many ways one of our most progressive cities, a free aviation school for boys has been started. The 12 weeks' course includes instruction in the theory of flying and in the practical aspects of aircraft engines. Some 2000 youngsters are concerned. Our photograph shows the boys at work, busily engaged on an air-cooled engine. A gigantic model plane meet concluded the first course.

The Rohrbach "Romar"

AMERICAN constructors have not of late years given the large three-engined commercial flying boat the attention that it deserves. The Germans have developed this type intensively and their practice deserves very careful study. The Rohrbach Company of Berlin has quite recently produced a very large flying boat which is intended for use between South America and Spain. This is known as the Rohrbach *Romar*, and was built on special order for the German Luft-Hansa, the great German air transport service.

The *Romar* is equipped with three engines, giving a total of 2160 horsepower. It carries 12 passengers and a crew of five men, and has a range of nearly 4000 kilometers or about 2500 miles, with a pay load of 2400 pounds. With a span of 113 feet, and a wing area of nearly 1900 square feet, the gross weight is approximately 42,000 pounds. Maximum speed is 136 miles per hour.

An outstanding feature of the *Romar* is the care which has been taken to supply the huge flying boat with every possible aid to navigation, auxiliary apparatus and safety devices. The construction is of the well known Rohrbach type, entirely in dural, with wings and hull covered with dural sheet. The accompanying drawing gives probably a better idea of the arrangement of the flying boat than could any photograph.

The items on the drawing are as follows:

(1) is a collision compartment. This is a watertight compartment which serves to protect the rest of the hull in case of a bad landing, or a crash into the side of a dock.

(2) is a special sound-proof room for the wireless operator and the navigator. There is plenty of room here for astronomic navigation.

(3) is the pilot's compartment. It is entirely enclosed but provides ample vision through the windows of Triplex glass.

(4) is a large 12-passenger cabin provided with good head and aisle room. Nothing is so important as to give the passengers a sense of spaciousness in long distance flights.

(5) is the entrance hall and stairway. The entrance is correctly placed at the back of the cabin, so that passengers are far from the propeller blast. With the boat set down low by the tail there is maximum ease of entrance into the boat.

(6) is a baggage compartment entirely distinct from the passenger cabin. Carrying baggage together with the passengers is considered to be a highly dangerous practice, since there is hazard of passenger injury by shifting of heavy baggage.

(7) is the compartment reserved for the mechanics who have from this spot the readiest access to the engines.

(8) and (9) are the wireless and light generators, which are presumably wind driven.

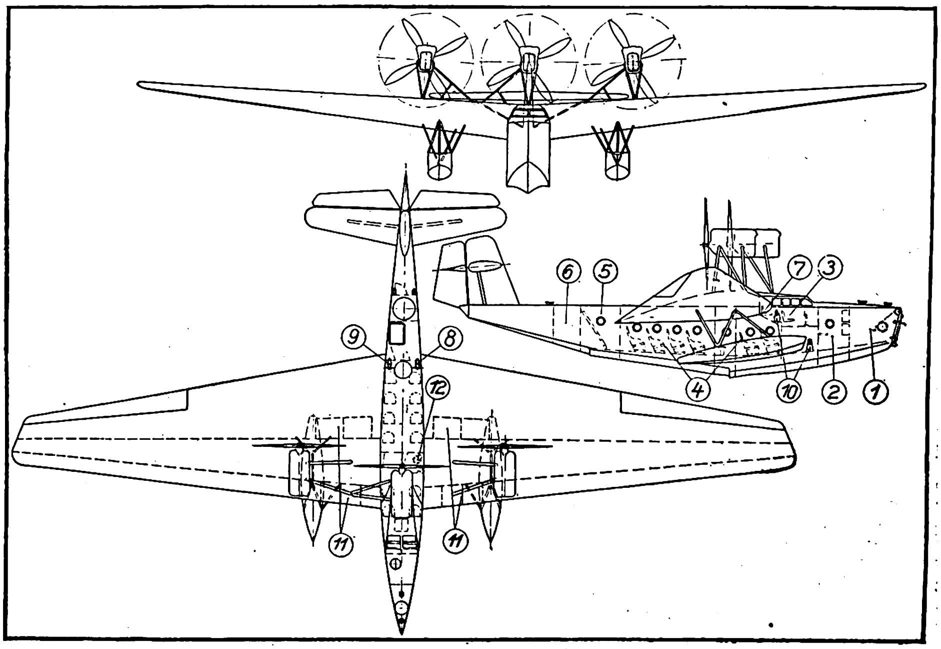
(10) is an auxiliary engine which can no doubt be used to drive the generators when the seaplane is at rest on the water, a particularly useful precaution in case of forced landing.

(11) indicates the tanks placed in the leading edge of the wing so that the blast of air may be relied upon to extinguish a fire.

(12) is the indispensable wash-room.

Parachute for the Entire Plane

A paper which attracted considerable interest at the Congress on Safety in Aviation was that of Major E. L. Hoffman, of Wright Field, who discussed the question of parachutes. It is held by most authorities that individual parachutes for the average passenger are out of the question. Sliding the passenger through the floor, with a parachute attached to his seat which will open up automatically as the seat falls, is a plausible idea which offers many difficulties in

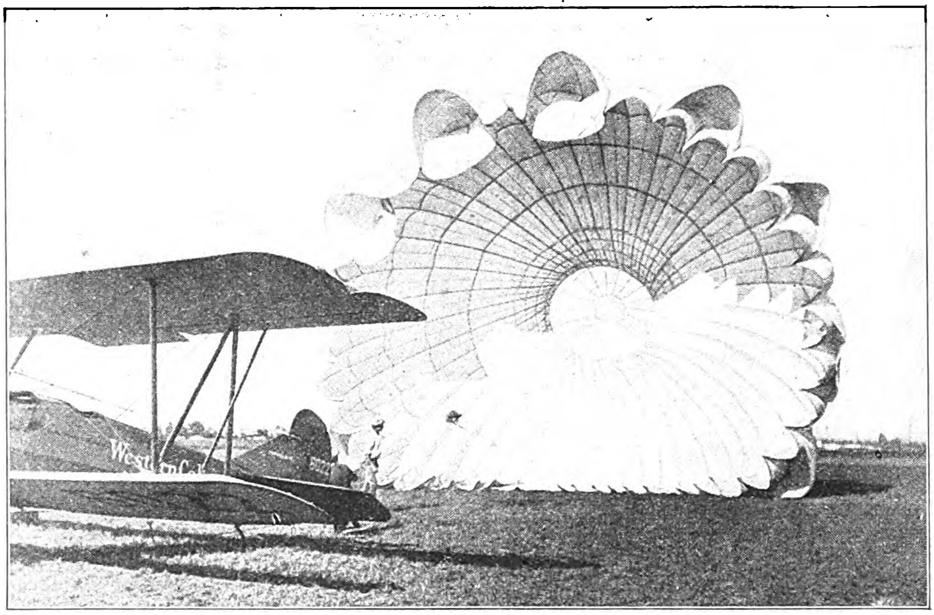


These drawings give an excellent idea of the design and construction of the Rohrbach *Romar*. In the text are given the designations of the numbered parts.

its realization. Attaching a parachute to the cabin and releasing the cabin in an emergency is also a doubtful solution.

Major Hoffman made a strong case for the parachute large enough to support an entire plane. He has actual experiments to back up his views. He has already made tests with a giant 'chute, 84 feet in diameter, which successfully carried to the ground a 1600-pound bomb. The preliminary test offered one difficulty, however. When the 'chute landed it refused to deflate, and an automobile had to be used to chase the errant and billowing giant across a field.

The next experiment will include a quick-release mechanism. When the 'chute is used for a whole plane, the pilot will actuate the release mechanism just before landing. Similar experiments are also being made by a west coast aviator, Herd McClellan. His parachute measures 85 feet in diameter. Its huge size can be gauged by comparison with a Travel-Air plane, as shown in our photograph.



Experimenting for safety with a huge 'chute capable of lowering an entire plane

Policemen of the Air

THE Rules of the Air as devised by the Department of Commerce have done much to increase aviation safety. Generally speaking, aviators are only too anxious to observe such rules, but as air traffic increases, black sheep may creep in and it will be quite a problem to enforce the rules with the rapidity which is essential in flying. There is also the difficulty of signalling to the pilot who is breaking rules. The police force of San Diego has hit on a very simple method. When an aviator is stunting over prohibited areas, flying too low or breaking some other regulations, the flying policeman shows him the side of his fuselage on which is painted in huge letters, the curt sign, "Land At Once."

Aircraft Diesel Engines

FIRE prevention has and is engaging the attention of aeronautical engineers in every civilized country. The French in particular are encouraging the production of such devices as will prevent a back fire from reaching the carburetor, will automatically extinguish incipient fires, and so forth.

The very best method of preventing fire, however, would be to use a heavy non-inflammable fuel, but such a fuel cannot be used in an engine of the ordinary gasoline type. It can only be employed in the Diesel or semi-Diesel. In the Diesel engine, the compression at the end of the compression stroke may be as high as 550 pounds per square inch, and fuel is injected as a spray under a pressure of as high as 1100 pounds per square inch, a two or even three-stage compressor being needed for the fuel injection. In the semi-Diesel there is the same injection of fuel at the end of the compression stroke, but lower pressures obtain both in the cylinder and in the injection of the spray, and a hot-spot has to be provided in the clearance space.

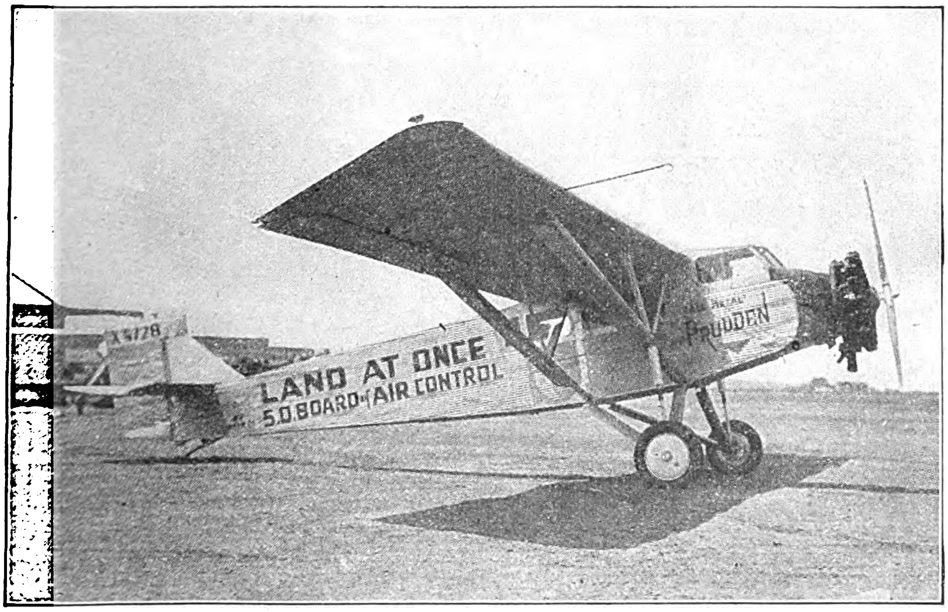
The Diesel and semi-Diesel, because they work at such very high pressures, are much more efficient than the ordinary gasoline engine, but owing to the enormous pressures in the cylinders and due to the compressors required they are apt to be very heavy for a given horsepower. Also, the injection of fuel at the top of the stroke limits the speed of the engine. In spite of these difficulties the Packard Company announces that it has developed an aircraft Diesel engine, which has been flown in a Stinson-Detroiter cabin monoplane of standard design.

The Packard aircraft Diesel is of the radial air-cooled type, developing about 200 horsepower and weighing less than three pounds per horsepower. No other details have been disclosed so far by the Packard Company, and since no information will be given out until a comprehensive program of ground and flight tests has been completed, it is possible only to speculate.

We believe that the engine is of the semi-Diesel rather than the full Diesel type; that both the compression and the injection pressures are far less than in the Diesel engines used in stationary practice; that to secure lightness, steel cylinders of great unit strength have been employed instead of cast iron; that dural has been used freely in all other parts with lightness in view; that a single-stage compressor of the impulse or plunger type is employed; that a single compressor is used with a suitable distribution of pressure to each cylinder; that extreme care has been used in the design of the injection valve; and that some device has been used to secure complete mixture of the fuel with the compressed air in the cylinder as well as rapid combustion.

It is the opinion of many authorities, as a result of the long experimental work which has been carried out both here and abroad on the automotive Diesel engine, and the great deal of research work carried out on fuel injection, that all the elements of the aircraft Diesel are already at hand. Engineers will refine further and assemble these elements in practical form.

The Diesel engine, dispensing as it does with carburetor and ignition system, will greatly increase the reliability of the aircraft power plant, as well as eliminate the fire hazard. We do not believe that there will be at first a very great reduction in the fuel consumption per horsepower-hour, because the pressures employed in the aircraft Diesel or semi-Diesel will not approach those of the stationary Diesel. Eventually a compromise will be arrived at between weight and fuel economy. Particularly for long distance flights will increased economy in fuel consumption permit of the use of an engine of somewhat greater weight per horsepower than in the present gasoline type.



Aerial policemen in California now use this flying sign to warn law violators

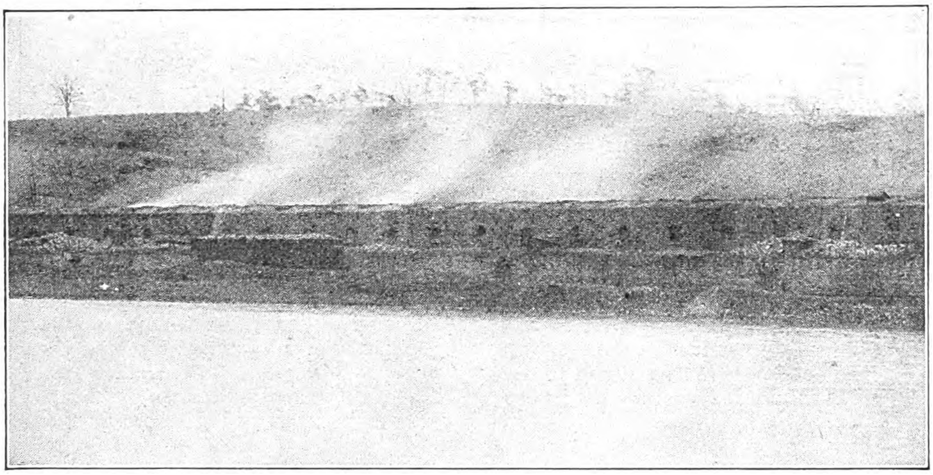
$300 \cdot 84) \cdot 80 - x) = (100)(x - 0) + 80.89(x - 0)$

Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

By-Product Process Has Almost Supplanted Beehive Coke Ovens

BY-PRODUCT coke has replaced all but 15 percent of the coke produced in the United States, rising from 27.5 percent in 1913 to 86.2 percent in 1927, according to C. J. Ramsburg, vice-president of The Koppers Company, Pittsburgh.



Typical installations of beehive ovens for coke manufacture. This type of oven was formerly common throughout the soft coal districts, but is now becoming extinct due to the increasing use of by-product ovens. The clouds of smoke arising from these ovens contain waste ammonia, benzol, coal tar, and other valuable substances which are saved in the modern by-product ovens

Mr. Ramsburg says that the influence of chemical engineering and chemical research since the World War, has been greater than that of any other branch of technical knowledge. It has been in the same period, he explains, that the by-product coking industry has made such great strides in America. By 1929 Mr. Ramsburg expects by-product coke to account for 90 percent of the coke produced in this country.

"By-product coke plants will be built for city gas and for domestic fuel supply," he says. "At present a large number of cities in the United States receive a substantial part of their gas from coke ovens. About 20 percent of the gas distributed by manufactured gas companies now comes from coke ovens.

"The gas industry is a unit in the belief that in the future the base load gas for practically all locations will be coke oven gas or coal retort gas and for this reason there probably will be a large number of small and some large plants built in the future."

Methane as Successor to Present Manufactured Gas

REVOLUTIONARY developments in the chemistry of gas may make it possible for the gas companies of America to produce a harmless form of gas which can be breathed in quantity without danger or discomfort, Arthur D. Little, eminent consulting chemist and President of the Society of Chemical Engineers, declared at the recent convention of the American Gas Association.

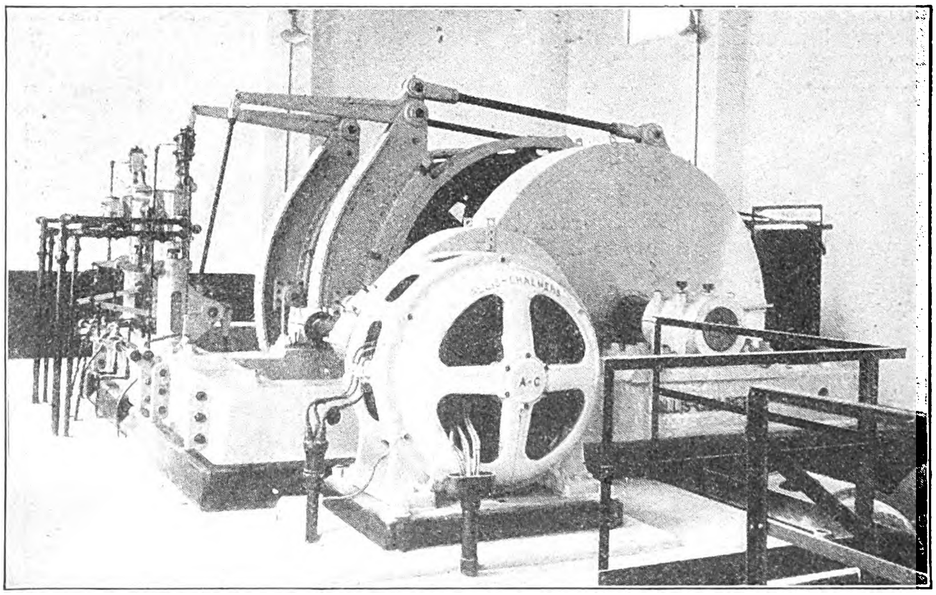
The new gas, Dr. Little explained, can be derived from the conversion of water gas to methane or from the direct catalytic treatment of mixtures of coal gas or coke over gas with water gas in such balanced proportions that the required hydrogen is present in the proper ratio to the carbon monoxide for the production of methane. Dr. Little said the methane would double the energy-carrying capacity of the industry's distribution systems and would enable the gas companies to furnish gas which would require no primary air at the burner.

Speaking of the production of "dry ice" as a major by-product in the manufacture of methane, Dr. Little said: "If the price of solid carbon dioxide, which is now selling at five to ten cents a pound, could be reduced to two cents, an unlimited field for its use would be opened up. The gas company would then be a logical producer of the material and might be able to take over the distribution of both heat and cold commercially. A gas works of the size of that of Boston, operating on the methane cycle, would be able to produce about 500 tons of solid carbon dioxide daily, the equivalent of 1500 tons of ice."

It is also possible, he said, to develop methods by which the gas industry will be definitely tied in with the production of motor fuel. He said his laboratory had demonstrated one such method by which, through the vapor-phase cracking of gas oil, there is obtained 1200 cubic feet of 1500 B.T.U. gas for enrichment use, together with 12 to 14 gallons of crude motor spirit, four gallons of fuel oil and 14 to 16 gallons of cycle stock.

Cure For Carbon Monoxide Poisoning

DEADLY carbon monoxide, a constituent of illuminating gas and automobile motor exhaust, takes a constant toll of life from the careless and unfortunate. Because it combines so avidly with human blood, the treatment of victims by ordinary methods of resuscitation is almost futile. Recently, however, a method for the cure of carbon monoxide poisoning was reported by L. Schmidt of Kiel, Germany. By



Recently installed hoist in a Portland cement mill at Thomaston, Maine. Limestone, quarried nearby, is elevated to the crushing plant by means of this hoist, which is operated by a system of relays without attendants. In operation, it gives an uncanny impression of human intelligence as the nine-foot drum-hoist starts and stops at the will of the distant operator

confining cats, rendered unconscious by carbon monoxide, in a chamber filled with pure oxygen in which the pressure oscillated between 2.3 and 2.5 atmospheres in synchronism with the breathing of the cats, the specimens were revived in two minutes and were removed from the chamber in full health within a half hour.

Sulfur Recovered In the Gas Plants Is Boon to Farmer

RECENT reports from the Pacific Coast again describe the remarkable variety of sulfur recovered by many of the larger gas plants and used with effective results in agricultural work.

According to K. N. Cundall of the Pacific Gas and Electric Company, San Francisco, the sulfur has unusual properties as an insecticide and fungicide while, in addition by reason of its extremely small particle size, it shows marked activity in the neutralization of alkaline soils.

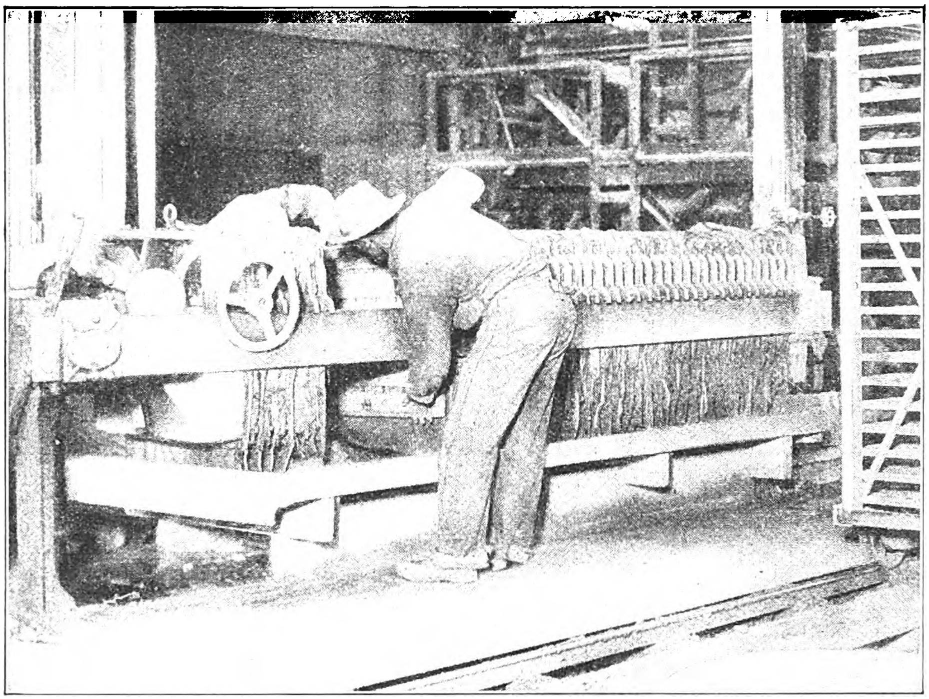
"Sulfur recovered by gas plants," Mr. Cundall reports, "has been tried recently on such blights as asparagus rust, peach, apple, and rose mildew, and rust on prunes. Additional work has been done with the cotton leaf hopper and lettuce mildew, and as a soil fertilizer and neutralizer for black alkali.

"The sulfur has been applied in districts ranging from Mexico to Canada, east to the Mississippi, and through the cotton belt in the South. It has been interesting to note the rapidity with which alkaline soils may be reclaimed through comparatively small amounts of the product. One user reports that he was able to plant alfalfa within three months' time after an application, when ordinarily a whole season would have elapsed before suitable results could have been obtained.

"Tests made in two sandy California soils showed the speed of oxidation to sulfate of recovered sulfur as compared with two commercial brands. The recovered sulfur was from 20 to 30 percent more nearly oxidized within a three months' period than were either of the two commercial grades which were simultaneously used.

"Additional tests on three species of red spider showed that the recovered sulfur has remarkable killing power as well as excellent spraying qualities. Considerably less is required of the recovered than of the commercial grades. Other tests have failed to produce another form of sulfur which is superior to the recovered product for use as an insecticide and fungicide in a whale oil soap."

Most of the recovered sulfur particles are smaller than 15 microns and many are too small to be measured.

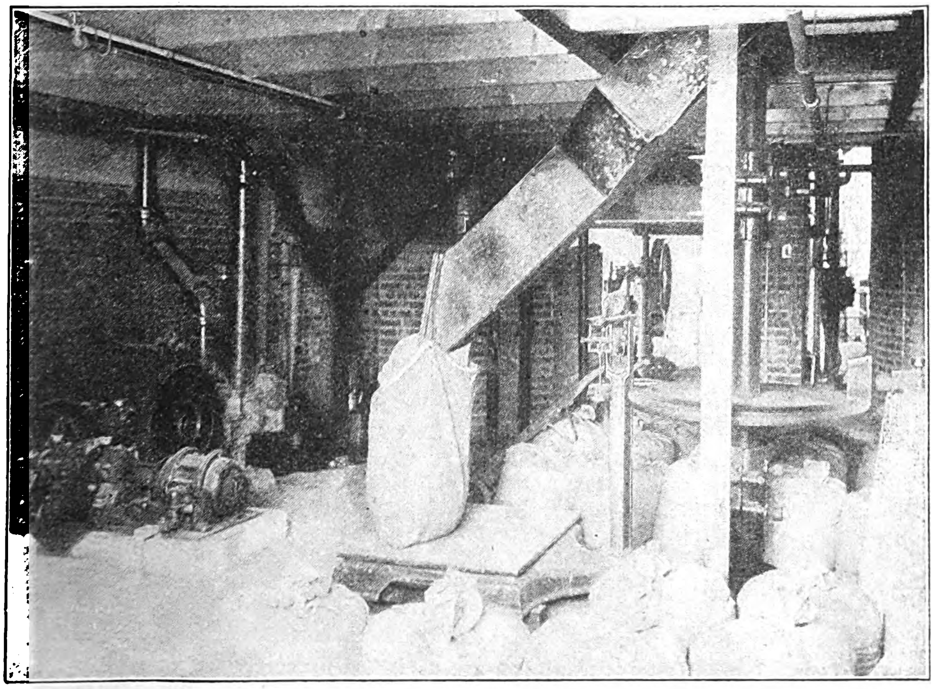


Courtesy *Chemical & Metallurgical Engineering*

Filter press used for preparing cakes of recovered sulfur sludge for the tunnel drier in a California gas plant. The sludge is dried in order to sell the recovered product in competition with commercial brands in a lime-sulfur mixture or as a dry gray dusting powder. It has been demonstrated that it is possible to dry this sludge several different ways without injuring its toxic properties. The recovered sulfur has unusual properties as an insecticide and fungicide, and exhibits marked activity in the neutralization of alkaline soils, according to tests recently held in widely scattered sections of the United States

Wax Crayons From Coal Tar

THE suitability of wax extract from coal tar produced in the low-temperature carbonization of coal, for use as a base in the manufacture of colored wax crayons, is being investigated at the Pittsburgh Experiment Station of the United States Bureau of Mines, Department of Commerce. Several commercial colored crayons have been analyzed and similar crayons have been made up, using the tar wax. From experiments so far made this wax appears very well suited to the purpose. It has a high melting point, which doubtless will render its use advantageous in making crayons for particular purposes.



Sacking powdered tin oxide for re-use in weighting silk, after the wash-water sludge has been dried in the spray tower. The illustration shows the base of the spray tower, where the recovered tin oxide is being sacked

Reclaiming Tin From Silk Weighting Washings

ONE of the steps in the weighting of silk consists of immersing the de-gummed fibers in a solution of stannic chloride. After the required time, the silk is removed and placed in washing machines where it is treated with large volumes of water to precipitate the tin absorbed by the fibers as an insoluble hydroxide or hydrated oxide, and to remove the excess stannic chloride. While the percentage of tin contained in wash waters is very small, it represents approximately one third of all the tin used by the weighters, and when salvaged, its value is considerable. The efficient and complete recovery of this tin is therefore of great importance.

Gibson Buttfield, writing in *Chemical and Metallurgical Engineering*, describes the novel process used in recovering the tin contained in the one million to four million gallons of water used in large silk plants.

In the operation of the new process, the tin-bearing solution, on leaving the wash machines, is neutralized by the automatic and continuous addition of a lime slurry, thus securing practically complete precipitation of the tin. The precipitated tin is allowed to settle and the sludge is continuously pumped to an overhead storage tank, flowing thence by gravity to a spray drier where it is instantaneously dried and automatically delivered to barrels or bags, for shipment. Continuous operation, from the time the solution leaves the wash machines to the shipment of the oxide, is the result.

Surplus Military Explosives Used Industrially

MORE than 126,000,000 pounds of TNT and other surplus military explosives accumulated by the government at the close of the World War have been used for industrial purposes, states Dr. Charles E. Munroe, Chief of the Explosives Division, United States Bureau of Mines, Department of Commerce. These explosives have been used in road building, in construction of dams and reservoirs, in draining swamps, in clearing cut-over lands and for other useful purposes which have added materially to the wealth of the nation.

After the entrance of the United States into the World War the nation set about the production of military explosives on a scale never before undertaken, and this work continued with such acceleration that when the armistice was declared, the country was producing military explosives in quantities never before realized. There is little doubt, Dr. Munroe points out, that this developed capacity was a material factor in ending the War. A consequence, however, was the accumulation at various points in this country of enormous stocks of high explosives and propellents, whose safeguarding during storage and transportation constituted a serious and costly obligation, while entailing a menace to the communities near which the material was stored.

Inspection and testing of the TNT stored for ten years have shown the explosive to be in the first-class condition and entirely suitable for use as a blasting agent.

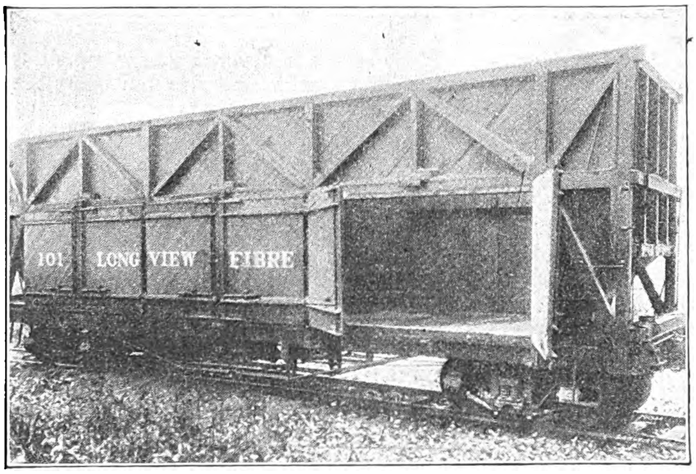
Eliminating Odors in Paper Making

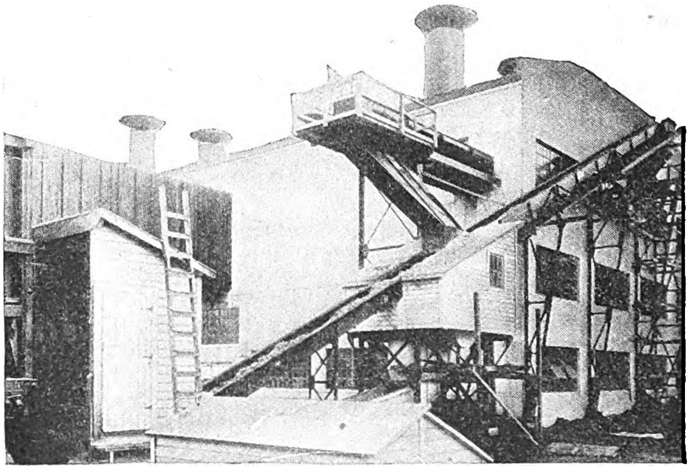
EVER since the infancy of the science, chemistry has been popularly associated with evil smells. While the characteristic odor of some laboratories and chemical plants provides a basis for such an association, it must be said in fairness to the chemist that his efforts in eliminating unpleasant odors are just as effective as in creating them.

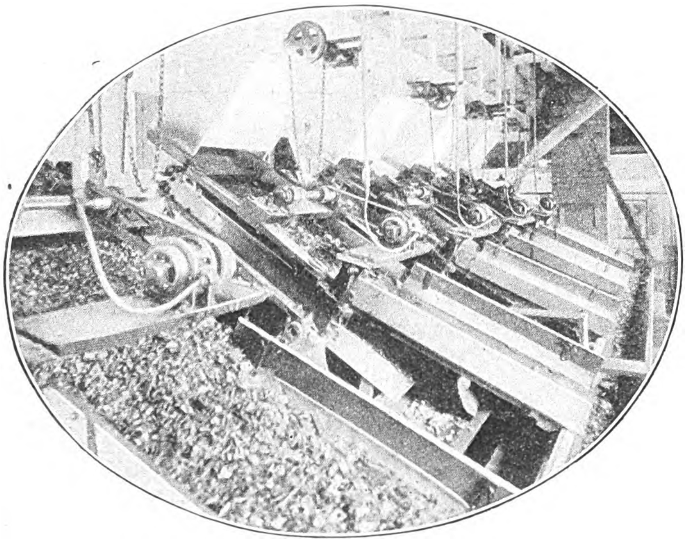
A case in point is described by R. S. Wertheimer in a recent issue of *Chemical and Metallurgical Engineering.* An important factor in limiting the development of the kraft-paper industry has been the obnoxious odor, produced in recovery of the spent cooking liquor. This fact has precluded the establishment of plants in thickly settled communities where manufacturing facilities are most suitable, and has forced development in isolated places, often with greatly increased capital and operating costs. By skillful application of chemical engineering, the Longview Fiber Company has eliminated this nuisance, and erected a modern mill at Longview, Washington, in which wrapping paper is produced from waste fir lumber without offending the most sensitive nostrils.

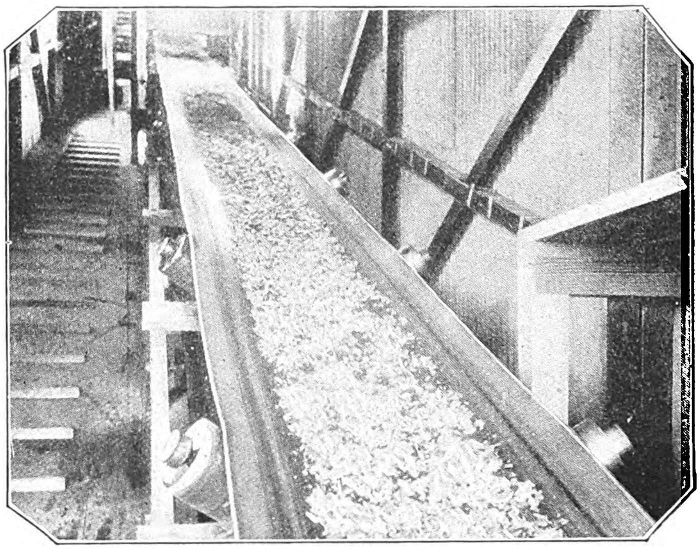
This new mill is also note-worthy in that it uses refuse fir lumber exclusively for its pulp and for fuel in its power plant. The mill adjoins the property of the Long-Bell Lumber Company, the largest lumber mill in the world. The scrap lumber is chopped up into chips for pulping and for fuel under the boilers.

Malodorous vapors from the digestors, wherein the chips are cooked to a pulp, are conducted to a large condenser which removes part of the unpleasant constituents. Condensate and non-condensable gases are then led to a gas washer from which they are removed under pressure to furnaces in

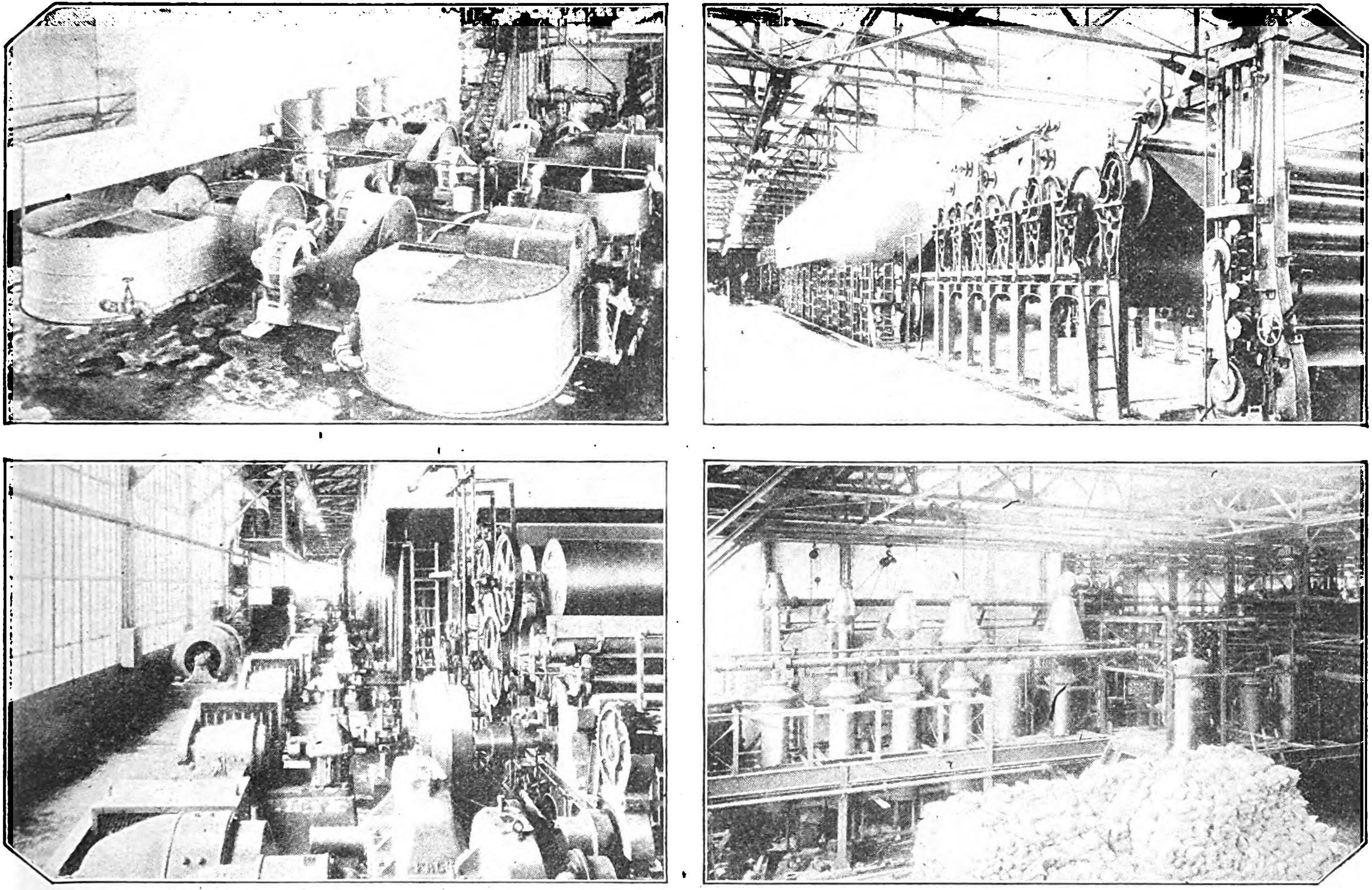








Important steps in the manufacture of paper from refuse lumber. *Upper left:* Specially designed car for transporting refuse lumber for paper pulp, and also for use as fuel in the mill. *Upper right:* Conveyor carrying chips to the boilerhouse to be used as fuel. *Lower left:* Chips for pulping are classified by screening over this battery of shaking sieves. *Lower right:* Screened chips being automatically weighed and sampled, while being moved from the storage bins to the digestors for conversion into the pulp from which kraft paper is made



Advanced stages in the manufacture of paper from wood pulp. *Upper left:* "Beaters" which reduce the size of the fibers after the digestive process. *Upper right:* The pulp emerges from this "board machine" in sheets 133 inches wide. This machine produces 100 tons of kraft paper a day. *Lower left:* This battery of motors provides the electric drive of the board machine. *Lower right:* Evaporator and dehydrator, enclosed to eliminate the obnoxious odor of the cooking liquor which usually makes a paper mill an undesirable neighbor

which the odorous gases are burned and rendered odorless.

Another usual source of odor is the recovery of cooking liquor, but at Longview a closed system of evaporators is used which concentrates the liquor so that it can be burned to "black ash" which reacts with the sodium sulfate fed to the furnace to form sodium sulfide "green liquor" which is used for the next digestion. Surplus heat from the furnaces is recovered in a waste heat boiler.

The paper-making equipment of the Longview Fiber Company consists of a 133-inch trim Black-Clawson board machine producing close to 100 tons of kraft test liner daily. This product is used as the inside and outside liners in corrugated shipping containers. It is made between 15 and 30 thousandths of an inch thick, depending on the type of container desired.

Recently a paper machine has been installed to produce 30 tons a day of lightweight wrapping and bag paper.

Sulfur in Gasoline

CORROSION of wrist pins in automobile engines using high sulfur fuel has been studied by S. H. Diggs of the Standard Oil Company of Indiana (Casper, Wyoming). The possibility of saving a very considerable amount of gasoline now lost in that part of the refining process which reduces its sulfur content, makes it important to find ways of using fuel in automobiles higher in sulfur and to this end it is necessary to know first just what action sulfur has in the engine. In reporting the results of his investigations to a recent meeting of the American Chemical Society, Mr. Diggs said in part:

"Excessive sulfur in gasoline does cause serious corrosion of moving parts within the crankcase, especially in cold weather and when frequent stops are made.

"There is no evidence that such corrosion occurs in warm weather or to any great extent on cars or parts that are kept continuously running during the day and in heated garages at night.

"There is no evidence to indicate that anything other than sulfur in the gasoline is to blame. Sulfur combined in the lubricant is not to blame except in so far as it may actually be burned in the cylinder.

"The amount of corrosion is disproportionately greater for high-sulfur than for low-sulfur fuel. This may be explained on the following grounds: The crankcase oil contains small amounts of material which will neutralize the sulfuric acid. In the best of conditions, crankcase oil, after a few hours' use, always shows some traces of finely divided iron and when used on dirt roads contains some road dust which is usually alkaline, often consisting essentially of carbonate of lime. If the amount of sulfuric acid formed is insufficient to react with finely divided iron and road dust, no injury results to the solid metal parts. Therefore, a certain small amount of sulfur in gasoline is not injurious. When the amount of acid formed in the crankcase becomes greater than that which can be neutralized by the finely divided iron and road dust, corrosion soon begins.

"From these tests, it is evident that a sulfur content of 0.040 percent does no harm, that 0.151 percent sulfur does appreciable harm, and that 0.458 percent sulfur does very great harm. Just where to draw the line is hard to say. It is probable that conditions in these experiments were decidedly more severe than are usually met in the actual operation of an automobile. It is also obvious that the condition of the car as regards tightness of piston rings is a material factor, as well as the type of bearings. It would seem, however, from the data given that 0.100 percent would be a fair dead line. No doubt a lower sulfur content is desirable, but it is probable that this amount would cause no appreciable injury; on the other hand it seems very certain that 0.200 or 0.300 percent sulfur would cause very serious damage to a car operated intermittently in cold weather. As weather conditions and the way the car is used vary so greatly, no exact figure can be given for the maximum allowable sulfur."

Possibilities in redesign of engines to utilize high sulfur gasoline have been studied by H. C. Mougey of the research staff of the General Motors Corporation, (Detroit). His conclusions are stated in part as follows:

"It has been estimated that if the oil industry could raise the sulfur limit of gasoline from 0.10 percent to 0.30 percent, a saving of 50 million dollars per year in refining costs would be possible. It is recognized that the cause of corrosion in automobiles is water formed by the combustion of the fuel, and that the corrosion effect of this water is greatly increased if it is con-

(*Please turn to page* 83)

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects; and Where to Get Them

A Survey Service

THE editor's aim in beginning this new department is to present compendia of bulletins, papers, et cetera, on a wide variety of researches and studies. It is intended as a guide to publications that are pertinent to vital problems, authoritative, and timely. It is planned to make this department particularly helpful to the busy executive who desires certain information but does not know where to get it.

Of the many publications of this nature that reach the editor's desk daily, only those that have, obviously, a wide appeal will be listed here, and these will be considered solely on their merits. Requests for publications mentioned, should always be addressed to the publisher or distributor — not to SCIENTIFIC AMERICAN.

The Editor.

Administration

Annual Report of the Governor of the Panama Canal for the Fiscal Year Ending June 30, 1928, contains both detailed statistics and general information relative to the Panama Canal and the Canal Zone. Many illustrations are included in this 134-page report, with varied statistical data relating to operations and maintenance, administration, services rendered and net revenue, traffic through the canal, and present conditions in the Canal Zone (to June 30). *Superintendent of Documents, Government Printing Office, Washington, D. C.—20 cents.*

The League of Nations, Cartels, and the Tariff, a paper by Mr. A. Cressy Morrison reprinted from the *Mining Congress Journal* of March, 1927. In this 14-page commentary an unofficial observer at the Geneva Economic Conference (1927) presents the case against internationalism and a defense of the present American policy of a high protective tariff. After a brief analysis of the international cartel, the writer compares modern European industry with American industry under our anti-trust laws. *Superintendent of Documents, Government Printing Office, Washington, D. C.—Gratis.*

A Standard City Planning Enabling Act (Building and Housing Publication Number 11) has just been published by the Bureau of Standards, in response to many requests for a standard act which might be used in various states in drafting city planning legislation. *Superintendent of Documents, Government Printing Office, Washington, D. C.—15 cents each.*

Civil Aeronautics is a 178-page memorandum on legal aspects of aerial navigation, which also contains an historical sketch of the legislative history of the Air Commerce Act of 1926. The present compilation is a revision of the 1923 edition of Law Memoranda Upon Civil Aeronautics. *Superintendent of Documents, Government Printing Office, Washington, D. C.—Gratis.*

Agriculture

Peaches (Bulletin Number 32, Commodity Prices in Their Relation to Transportation Costs). A 20-page bulletin of statistical data on production, prices, freight rates, markets and profits in the peach industry. *Bureau of Railway Economics, 1024 Transportation Building, Washington, D. C.—Gratis.*

Annual Report of the New York State Agricultural Experiment Station describes the experiments under way at the Geneva station. The report covers many investigations, including those dealing with soil fertility, feeding and breeding experiments, bacteriological problems of sanitary milk production and of food spoilage, diseases and insect pests of fruits and vegetables, dairy herd management, and studies with new fruit and vegetable varieties. *New York State Agricultural Experiment Station, Geneva, N. Y.—Gratis.*

Electricity

The Electrical Equipment Market in the Netherlands and Belgium (Trade Information Bulletin Number 578) has just been published by the Department of Commerce. The bulletin outlines the demand for electricity, cost, consumption, local manufacture of equipment, exports and imports of these two countries. *Superintendent of Documents, Government Printing Office, Washington, D. C.—Ten cents each.*

Electric Light and Power in the United States. The report of the rate research committee of the National Electric Light Association presents comparisons between the rates charged by municipal and private power plants. This 51-page report contains many charts and graphs, and an extensive bibliography on electrical rate making with special reference to analysis of costs and the classification of customers. *National Electric Light Association, 420 Lexington Avenue, New York City.—75 cents each.* (*50 cents to members of the N. E. L. A.*)

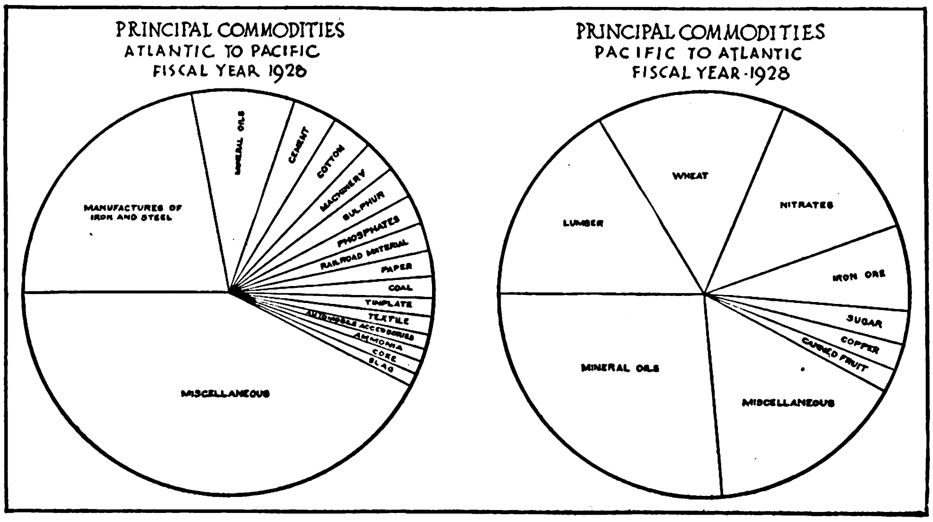
How to Begin the Application of Arc-Welding in Production Manufacturing, a 32-page supplement to the book "Arc-Welding—The New Age in Iron and Steel," contains specific and definite information on arc-weld design. The supplement is illustrated with drawings and photographs showing new designs adapted to the use of arc-welded construction in manufacturing. *Lincoln Electric Co., Cleveland, Ohio.—50 cents.*

Chemistry

Industrial Changes Due to Chemistry. A 20-page paper by Dr. Edw. R. Weidlein, Director of the Mellon Institute of Industrial Research, and President of the American Institute of Chemical Engineers. This paper provides a review of the major changes that have taken place in industry as a result of discoveries based on chemical research. *Mellon Institute of Industrial Research, Pittsburg, Pa.—Gratis.*

Italian Chemical Industry (Trade Information Bulletin Number 577) deals with the progress made by the chemical industry in Italy since the World War. This bulletin sets forth in detail the economic and commercial features of the Italian industry, with production and con-

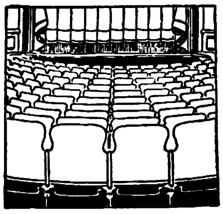
(*Please turn to page* 86)



A typical graph from the annual report of the Governor of the Panama Canal

This *grainless* wood offers new profitable opportunities for industrial progress

Each day new uses are being revealed for this product, because of its unusual workability, uniform strength, high resistance to moisture and other astounding advantages. Write today for a generous sample—sent free—and test for yourself its remarkable possibilities.



THEATRE SEATS

Industrial America . . . quick to grasp the importance of a product that would bring about significant manufacturing improvements and substantially lower operating costs . . . has already uncovered startling uses for Masonite Presdwood, the grainless wood board.

This easily worked material is made of genuine wood, torn apart and put together again without chemicals or any other foreign binders. It does not damage tools and will not crack, check, split or splinter. It is absolutely grainless.

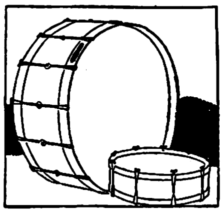
Presdwood cannot be destroyed by moisture and has a remarkable resistance to sudden changes in temperature. It is practically immune from warping, shrinking, swelling or buckling.

And when you have proved these facts for yourself, you will quickly realize why industry after industry has turned to it to reduce costs, improve a product or speed up production

There is little waste with Presdwood. It is easily handled. It can be used on any woodworking machine; it can be cut out, punched, die cut and scraped. It is perfectly smooth on the face side and requires no paint to withstand the elements.

New uses discovered daily

Each day new uses are being discovered for this remarkable product. Each day enthusiastic letters of praise are being received from a wide range of industries.



DRUM SHELLS

Motor boat hulls, truck bodies, tension boards for radio speakers, portable billiard tables, toys, bedroom screens and fire screens, store fixtures and table tops, show window flooring and show cases, interior finish and office partitions, radio boxes, paneling, closet lining and display booths, breakfast nooks and kitchen cabinets, signs and cut-outs of all kinds, suggest some of the many and varied uses of Presdwood.

Several railroads are now using Presdwood as paneling in their new Pullman cars. A box maker turned to Presdwood after a box of this material had withstood being dropped 1942 times when a similar box of conventional material failed after 871 drops. The Chicago Art Institute is using Presdwood as a backing to protect rare works of art. Campers' tables, safety wheels for bathing beaches, bread boxes, dust arresters for journal boxes and lining for elevator and ventilator shafts, suggest more of the seemingly endless uses of this grainless wood board.

Send for your sample

If discovering new and profitable applications for a product of unusual workability intrigues you, do not fail to write today for your free, generous sample of Presdwood. The chances are it will enable you to learn how to make a worthwhile improvement in some product.

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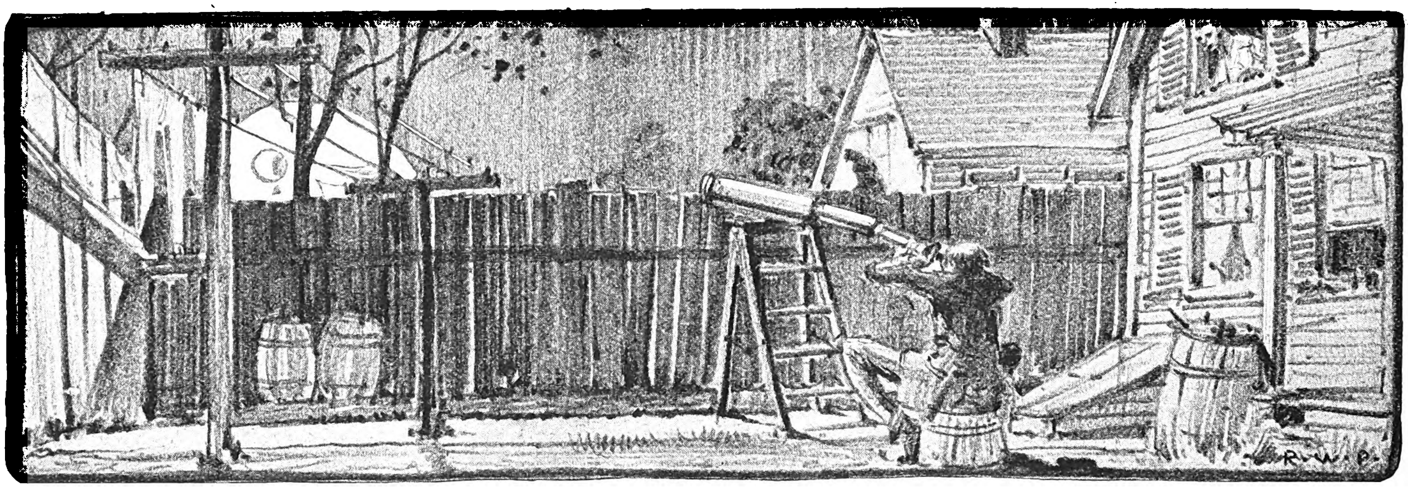
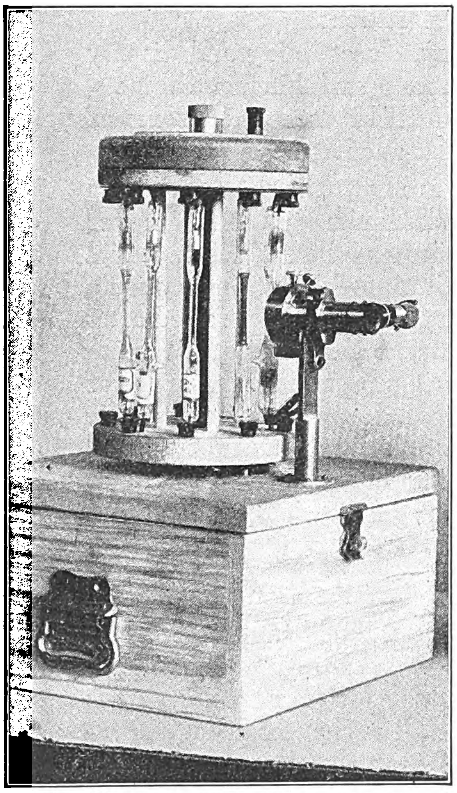


The Back Yard Astronomer

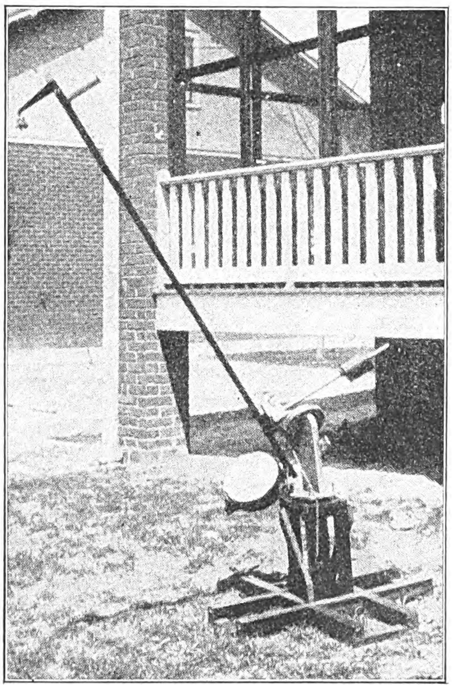
A Department Devoted to Interests of the Amateur Telescope Maker

"I HAVE visited Dr. Hale's laboratory here in Pasadena, California, several times to watch the progress and development of his amateur spectrohelioscope," says F. M. Hicks, 1315 South Oakland Avenue, that city. "The wonderful results he obtains by this instrument have impressed me with the desirability of trying to give the student and interested public a picture that will make them understand star spectra somewhat as he has accomplished this for sunspots.



The Hicks Spectra Demonstrator with its protecting case removed

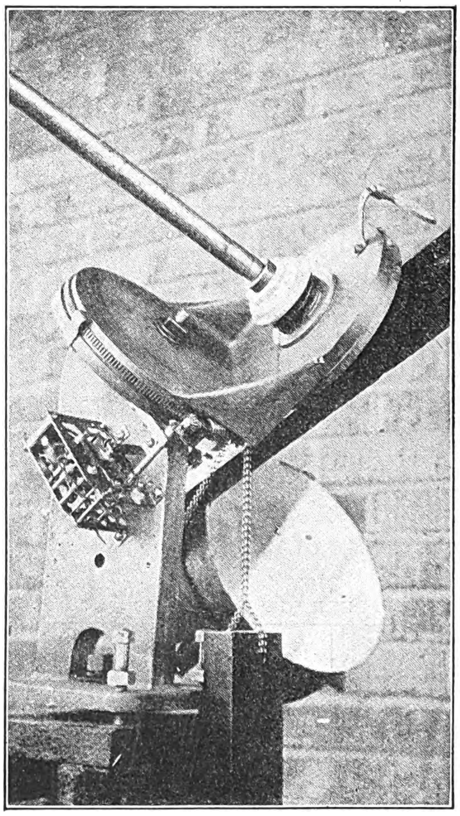
"The average man may know in a vague, general way that much of the astronomer's knowledge of the stars comes by way of the spectroscope, but the black and white spectrum lines as they are generally shown mean little to him. The accompanying photograph is the result of trying to bring these spectrum lines to him in color and action. By means of this instrument, which I have called the 'spectra demonstrator,' one can see and compare the spectra of a number of gases and metals—a veritable picture show in colors—and it will help the amateur or student to realize that when the astronomer with his telescope sees these same lines and colors in a star, he knows that the star contains the particular gas or metal that they have been looking at in this instrument.



Mr. Cooke's telescope of the "spinal column" or tubeless type

"Then, if we tell him further that the broad spectrum lines of one gas show the movement of gas in molecules, while the narrow spectrum lines in the adjoining tube which he sees at the same time, show the result of the knocking off of electrons from the gas atoms, he will not only obtain a beautiful sight—for the colors are wonderful—but he will begin to get some idea of electrons, atoms, and molecules, and their action in matter. This sort of a 'moving-picture show' interests and fascinates not only the man who knows little of physics and astronomy, but the student also.

"The instrument is complete, self-contained, is suited for both individual as well as class room use, and is operated by plugging in on the ordinary house light current. It contains eight vacuum tubes filled with gases, such as oxygen, hydrogen, helium, mercury, and so on; a holder for an open arc, to show spectra of metals such as iron, copper, salts, and so on; one 4000-volt

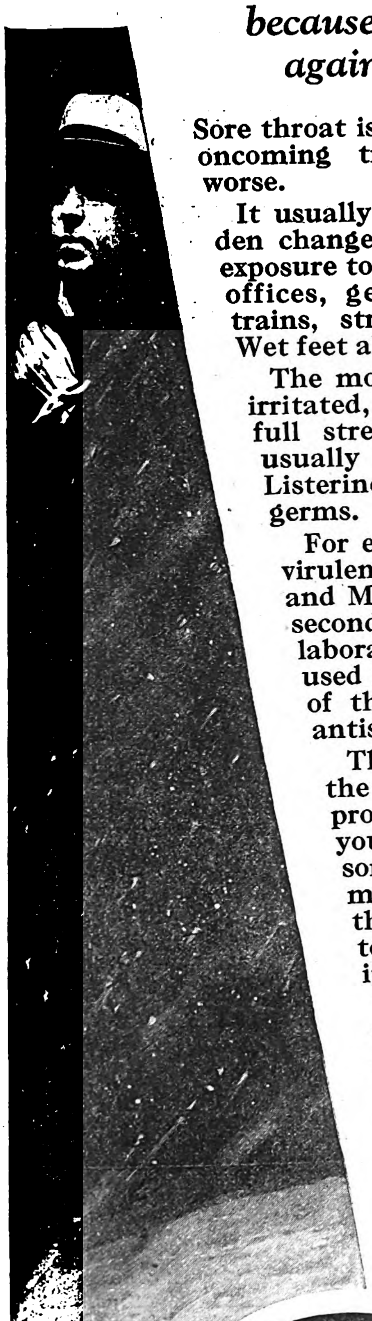


A detailed view of the ingenious clock drive of the telescope at left

After exposure—avoid Sore Throat

LISTERINE

Checks it quickly because powerful against germs



Sore throat is a danger signal of oncoming trouble—a cold or worse.

It usually develops after sudden changes in temperature or exposure to others in overheated offices, germ-ridden railway trains, street cars and buses. Wet feet also encourage it.

The moment your throat feels irritated, gargle with Listerine full strength. Sore throat is usually caused by germs—and Listerine full strength kills germs.

For example, it kills even the virulent B. Typhosus (typhoid) and M. Aureus (pus) germs in 15 seconds, as shown by repeated laboratory tests. Yet it may be used full strength in any cavity of the body. Indeed, the safe antiseptic.

The moment Listerine enters the mouth it attacks the disease-producing bacteria that cause you trouble. And unless your sore throat is a symptom of some more serious disease, calling for the services of a physician, Listerine will check it in an amazingly short time.

For your own protection, keep a bottle in home and office. It's an investment in health. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

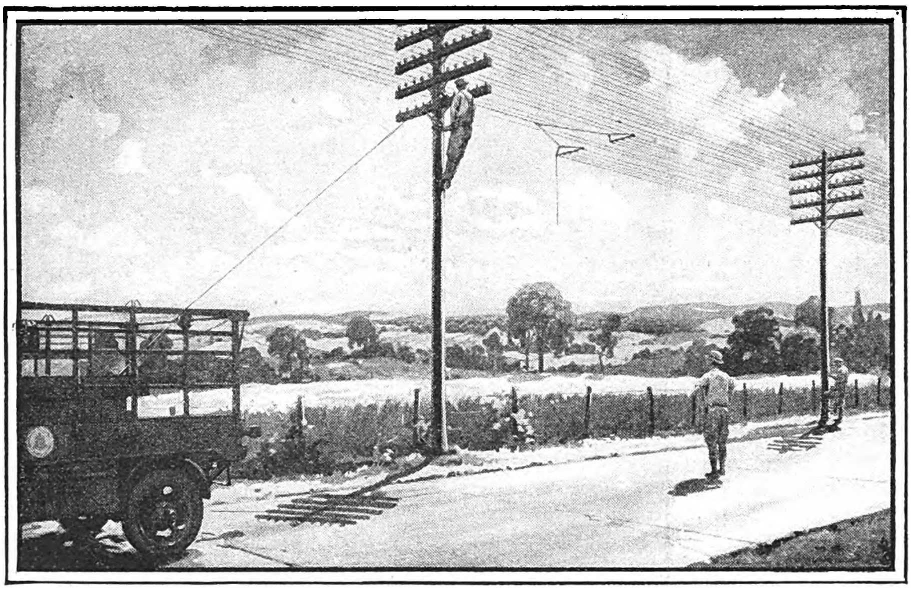
To *escape a cold* *use Listerine this way:*

You can materially lessen the risk of catching colds by rinsing the hands with Listerine before each meal, the way physicians do. The reason for this is obvious:

Listerine attacks the germs of cold on the hands, thus rendering them harmless when they enter the mouth on food which hands have carried. Isn't this quick precaution worth taking?

"GREAT!"

men say. They're enthusiastic about Listerine Shaving Cream. You will be also when you try it. So cool! So soothing!



The U.S.A. is only a few minutes wide

An Advertisement of the
American Telephone and Telegraph Company

BELL SYSTEM
AMERICAN TELEPHONE & TELEGRAPH CO AND ASSOCIATED COMPANIES

IN THE gold rush year of '49 a stagecoach succeeded in crossing the continent in about three months. Two decades later, for the first time, an unbroken stretch of railroad lay from New York Harbor to San Francisco Bay, and America was seven days wide. Today, by telephone, that entire width is only a matter of minutes. And these few minutes represent a round trip, taken in the ease of office or home.

The Bell System is ever busy reducing the width of America and the distance between cities. For example, during 1929 it will add to its lines nearly 2,000,000 of the new permalloy loading coils for correcting and maintaining the speeding voice currents.

Seven thousand miles of new intercity cable, $40,000,000 worth, will be added to the System to protect against storms and other slowing up influences.

In the last five years 350 major improvements, as well as thousands of others whose aggregate importance mounts high, have been made in telephone central office equipment.

Improved operating practices have eliminated the necessity of your "hanging up" and being called back in 95 per cent of toll and long distance calls, adding new speed and ease to out of town calling. You hold the wire and the operator does the rest.

Since New Year's Day, 1927, the average time for completing all out of town calls has been cut 35 per cent and at the same time the per cent of error has been further materially reduced.

There is no standing still in the Bell System. Better and better telephone service at the lowest cost is the goal. Present improvements constantly going into effect are but the foundation for the future's greater service.

"THE TELEPHONE BOOKS ARE THE DIRECTORY OF THE NATION"

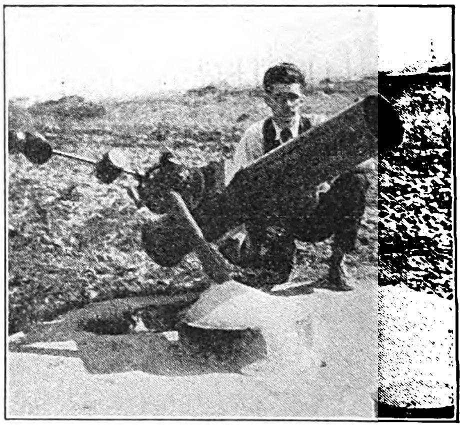
transformer and one 10,000-volt condenser, both properly insulated for safety; and one direct-vision hand spectroscope, with wavelength scale and device to show spectra of two gases at the same time, so that the lines and colors may be compared and examined in detail.

"The base box is 12 inches square, six inches high. On it is placed a revolving frame carrying the vacuum tubes. The spectroscope is held stationary in a socket in the base box, while the tubes revolve; thus giving a succession of spectra so they can be easily examined and compared.

"The instrument will be put up in a complete unit—a precision laboratory apparatus. It will be built by the same firm which is building the Hale amateur spectrohelioscope. The vacuum tubes may be purchased separately.

"The instrument has been seen and examined by some of the officials of both Mt. Wilson Observatory and California Institute of Technology and has received their warm approval. While it is not a cheap affair it may be duplicated in an inexpensive and simple form by the amateur, using a Ford coil for a transformer and a condenser made from less than a dollar's worth of tinfoil and glass; the spectroscope may be home-made, using a replica grating in place of prisms.

"In this shape the instrument is interesting and educational. It is perhaps my most valuable contribution to the advancement of the cause you are fostering. It is for the free use of the public."



Mr. Murray and his trim six-inch reflector mounted on concrete base

R. D. Cooke, Box 41, Nameoki, Illinois, believes in a clock drive and has made a simple but practicable one. He writes: "I am sending you some pictures of an eight-inch telescope with a clock drive, which may be of interest to some of your readers. I am extremely pleased with the way it works.

"The driving clock is the movement of a dollar-and-a-half alarm clock and serves merely to control the speed. The main source of power is the weight operating over a sprocket on the worm shaft. The large gear floats on the center pin and turns continuously. The casting carrying the hour circle rests on the edge of the gear and is carried along with it, except that it may be moved by hand to any position desired. As soon as the hand releases it, the clock begins to carry it along.

"Since making the pictures I have mounted a flashlight bulb under the reading glass for illuminating the declination circle.

(*Please turn to page* 85)

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An engineering firm of long standing has been requested to arrange contracts between holders of patented products and manufacturers seeking additional lines to manufacture.

Only patented products, or those for which application for patent has been made, will be considered. Submit sufficient data to enable us to determine whether further negotiations are desirable.

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METAL CAST PRODUCTS CO., Dept. S, 1696 Boston Road, New York City

Industries From Atoms

(Continued from page 77)

taminated with acids resulting from the burning of the sulfur in the fuel.

"Crankcase ventilation and control of the jacket-water temperatures by thermostats have been recommended to eliminate the condensation of water from the burning of the fuel and thus combat this corrosion. Records of tests and of performance in service in the hands of the public of engines equipped with such devices and operated on fuels of different sulfur content show that the thermostats and ventilators are of very great value in combating corrosion. However, it is concluded that, inasmuch as a large number of cars are not so equipped, an increase in the sulfur content of motor fuel at the present time is not in accord with the best interests of the automobile industry and the public."

Soap Used in Oil Refining

THE advertising man has convinced us that soap will do all sorts of splendid things, from floating to preserving a schoolgirl complexion, but it remained for a German chemist, Prof. Fritz Schwartz, to discover that soap makes an excellent reagent in the refining of mineral oil. The impurities in the distillates do not enter the soap solution but the soap is precipitated together with the impurities. The originator has compared this precipitation with the sulfuric acid and other processes and has found, especially in the case of transformer oils, that it is characterized by oils of a very slight resin formation.

Another substance developed abroad of use in mineral oil refining is "talloel" which is derived as a by-product in the Scandinavian cellulose industry. Apparently, the same principle is involved, since the caustic treatment of coniferous wood in paper manufacture produces a vegetable soap for which no very general use has heretofore existed. Such "soap" solutions should be cheaper for refining purposes than soap made from oleaginous fats.

"Little Bugs and Lesser Bugs" Succumb to New Insecticides

IT used to be quite sufficient to know that certain substances would kill undesirable insect pests. But nowadays chemists are watching the death throes of all sorts of bugs to find out just why some insecticides are more effective than others. This curiosity is not inspired by any sympathy for the insect victims but is merely the chemists' way of developing better insecticides.

Fluorides and fluosilicates have been shown to upset the respiratory metabolism of insects so seriously that their interest in the pantry shelf and the kitchen sink is abruptly terminated. Dr. David E. Fink of the Department of Zoology at the University of Pennsylvania, in reporting his investigations on the effectiveness of fluorine and arsenic insecticides at a recent meeting of the American Chemical Society, said, "Fluorine, like arsenic, is found in the normal tissues of plants and animals. The effect of feeding or injecting lethal doses of fluoride and fluosilicate compounds on the respiratory metabolism of insects, is to depress the carbon dioxide output more than the oxygen consumption, which is the reverse of the effect upon the gaseous

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From the office of
Mrs. Ballington Booth
34 West 28th Street,
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December 1, 1928

To the Editor

Dear Sir:

For many years I have been given the chance, through your columns, of reaching your readers with a plea for the wives and little children of the prisoners at Christmas time. This glorious holiday season that means so much in happy homes is a day of added loss and sadness to them.

The Volunteer Prison League seeks to dispel these shadows by sending such gifts as will not only make it a gala day, but add solid comfort in the cold winter months to come. In addition to Christmas cheer and toys, we send warm new clothing and shoes for the little feet that must tramp to school through mud and snow and which, but for our gifts, would be poorly shod.

The prisoners themselves in all our Institutions will be remembered by the State with Christmas fare and some kind of celebration, but their helpless dependents who bear the heavier burden are often forgotten.

Will the readers of this message help me send aid to these innocent sufferers? We try to make every dollar go as far as possible. I might add that the Volunteers of America is a duly incorporated organization, that our accounts are carefully kept and audited, and receipts sent for every gift.

We shall be most grateful for all donations of money, clothing and toys. They should be sent to Mrs. Ballington Booth, the Volunteers of America, 34 West 28th Street, New York City.

Believe me,

Very truly yours for our Country's prisoners,

Maud Ballington Booth.

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exchange obtained with arsenicals. These chemicals do not affect respiration to as great an extent as do the arsenicals. Whereas the former depress the oxygen consumption and carbon dioxide output 11 and 13 percent respectively, arsenicals depress them 36 and 40 percent respectively, indicating that arsenicals are from four to five times as toxic to respiration as the fluorides and fluosilicates. No marked difference in toxicity between fluorides and fluosilicates appears to exist when neutral solutions are employed, if we judge from their effects on respiratory metabolism of insects.

"There appears to be an affinity of fluorine for the calcium of the tissues; experimentally this may be demonstrated by making less toxic a lethal dose of fluoride or fluosilicate by a previous or simultaneous injection of a dose of calcium chloride. The effect of fluorine on the tissues is probably not so much the precipitation or removal of calcium ions from the cells (under normal conditions such losses may be replaced by the body) as the replacement of calcium by fluorine as a cell constituent."

Rubber Used as Binder for Foundry Cores

SAND cores used in the foundry industry have played a very important part in the development of the art of molding and in the reduction of molding costs. The removal of cores from the casting, however, is an expensive, laborious, and dusty task, often requiring the use of a pneumatic chisel or other tools. Cracked castings, due to hard cores which do not crush as the metal solidifies are sources of loss to foundries.

Recently there has been developed at the United States Bureau of Standards a new foundry core sand binder in which rubber is used as the basis of the core binder. The outstanding advantages are: (1) The cores crush readily, falling to loose sand of their own accord, so that the core sand may be poured from the casting instead of having to be dug out: (2) The cores have greater strength than a greensand core and extend the range of jobs to which a readily crushed core may be applied: (3) The cores are not oven baked; they are merely air-dried: (4) The cores are of high permeability and show remarkable freedom from blowing.

The new rubber core binder consists essentially of a solution of unvulcanized rubber in gasoline. The amount and type of rubber binder used in making cores depend upon the type of core sand, the size of the core, and the metal to be cast around it. The new binder has proved successful in producing sand cores for castings of lead, tin, zinc, brass, phosphor-bronze, bronze, aluminum, iron, and steel; in fact, it has been found satisfactory for almost all foundry cores.

Sawdust and Soft Sand Cleans Floors

A SWEEPING compound for linoleum, concrete and cement floors, made from a special grade of sawdust and soft sand which will not injure any floor has recently been put on the market. A consistent use of this preparation, the manufacturer claims, will soon brighten the dullest floor, keep the dust down and make the floor look as if it were scrubbed daily.

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The Backyard Astronomer

(*Continued from page* 82)

"To show the accuracy of the mechanism I sighted on the nebula in Orion, and then went into the house for nearly an hour. Going out again I found the nebula exactly centered in the field. I am tempted to try some photography with the telescope and would be glad to hear from anyone who has done any work of this kind."

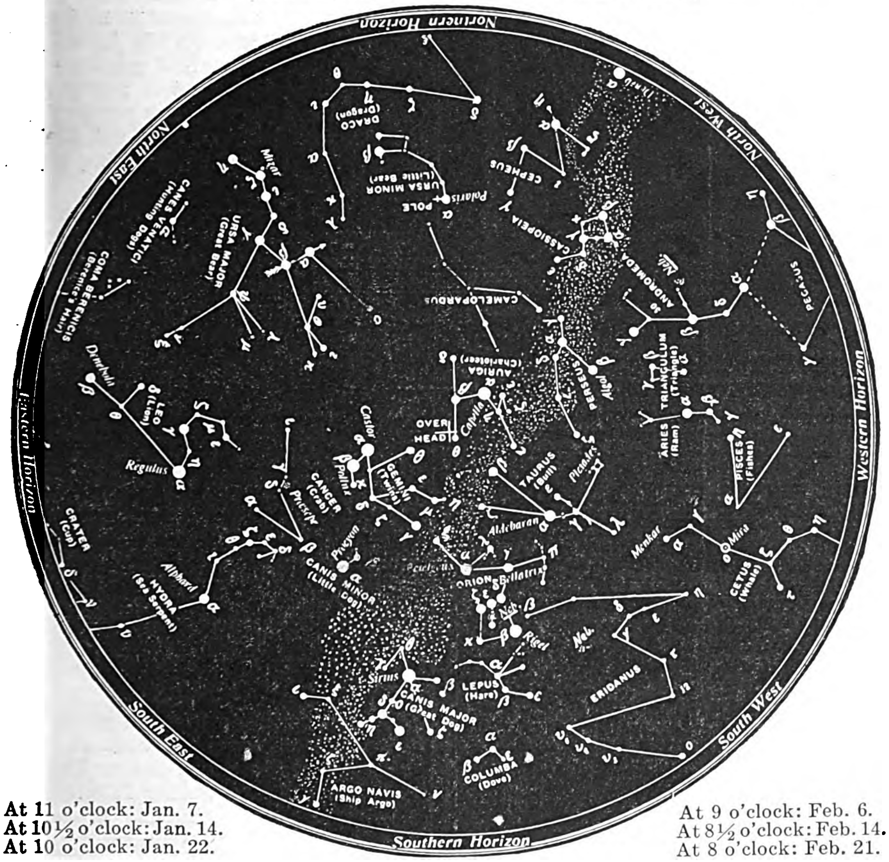
Martin G. Murray, a post office clerk at Huntington Beach, California, writes: "As soon as 'Amateur Telescope Making' was off the press, I purchased a copy. However it was not till the latter part of 1927 that I had the opportunity to begin work on my telescope. I am especially interested in the study of sunspots, and have just made an attachment that makes it possible to chart the spots. I am well pleased with the entire instrument and am very grateful for all help received through the SCIENTIFIC AMERICAN. I am enclosing a photograph."

¶ The Telescope Editor has just returned from an excursion in Europe, which included visits to several places of astronomical, and particularly telescope making, interest. Several large optical shops in Great Britain and Germany were visited. No real T.N. should leave London without making a sacred pilgrimage to Burlington House to see Newton's original reflector with its tiny mirror; nor fail to go to Florence where, at the Museum of Physics and Natural History, he may approach within close view of Galileo's famous original telescopes.

—*A. G. I., Tel. Ed.*

The Heavens in January

By PROF. HENRY NORRIS RUSSELL, Ph.D.


Northern Horizon
North East
North West
Eastern Horizon
Western Horizon
South East
South West
Southern Horizon
DRACO (Dragon)
URSA MINOR (Little Bear)
Polaris
POLE
CEPHEUS
CASSIOPEIA
CAMELOPARDUS
Mizar
CANES VENATICI (Hunting Dogs)
URSA MAJOR (Great Bear)
COMA BERENICES (Berenice's Hair)
Denebola
LEO (Lion)
Regulus
CRATER (Cup)
HYDRA (Sea Serpent)
Alphard
CANCER (Crab)
Praesepe
Castor
Pollux
GEMINI (Twins)
OVER HEAD
Capella
AURIGA (Charioteer)
PERSEUS
Algol
ANDROMEDA
PEGASUS
TRIANGULUM (Triangle)
ARIES (Ram)
PISCES (Fishes)
TAURUS (Bull)
Pleiades
Aldebaran
Menkar
Mira
CETUS (Whale)
CANIS MINOR (Little Dog)
Procyon
ORION
Bellatrix
Betelgeuse
Rigel
Neb.
ERIDANUS
LEPUS (Hare)
Sirius
CANIS MAJOR (Great Dog)
COLUMBA (Dove)
ARGO NAVIS (Ship Argo)

At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9:30 o'clock: January 29.

NIGHT SKY: DECEMBER AND JANUARY

MERCURY is an evening star all through January and may be best seen about the time of his greatest apparent distance from the sun, on the 22nd. At this time he is near perihelion, so that he looks nearer to the sun than usual. But to make up for this he is brighter. He is in Capricornus, 15 degrees south of the equator and should be easily visible in the fading twilight a little before 6 P.M.

Venus is also an evening star, but more than twice as far from the sun. By the end of the month she remains in view till 9 P.M. and is by far the most conspicuous object in the evening sky.

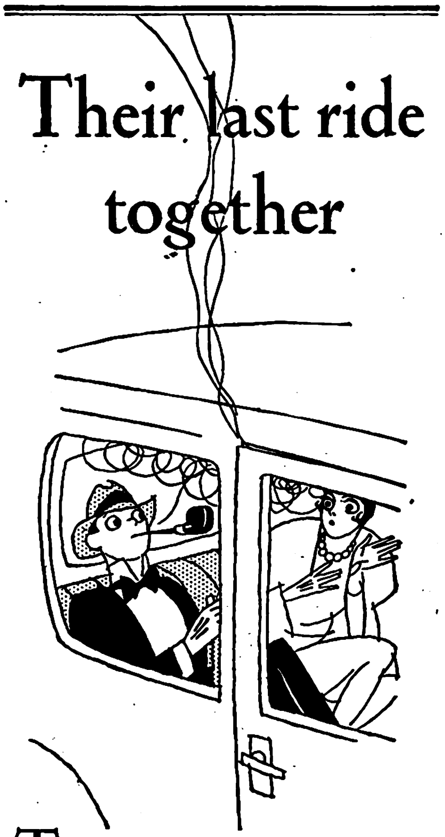
Mars, although receding from the earth, is still very bright. He is on the border between Torus and Gemini, in 26 degrees north declination. He rides very high in the evening sky and remains in sight till after 5 A.M.

Jupiter is in quadrature, 90 degrees east of the sun on the 22nd and counts as an evening star after that date, although he does not set till shortly after midnight.

Saturn is a morning star in Sagittarius, rising about 5 A.M.

Uranus is past quadrature, but observable in the early evening, and Neptune is visible in the morning.

The moon is in her last quarter at 2 P.M. on the 2nd; new at 7 P.M. on the 10th; in her first quarter at 10 A.M. on the 18th, and full at 2 A.M. on the 25th. She is nearest the earth on the 23rd and farthest away on the 7th. As she sweeps around the heavens she comes into conjunction with Saturn on the 8th, Mercury on the 12th, Venus on the 14th, Uranus on the 16th, Jupiter on the 18th, Mars on the 22nd, and Neptune on the 26th. None of these approaches is particularly close.



Their last ride together

THERE'S more than one reason why girls walk home. There's more than one bachelor who wouldn't have to stay that way if only some one would tell him about Sir Walter Raleigh. Oh well, for that matter, *we'll* tell him. It's milder, men, a lot milder, and it will do a lot to make that strong old briar of yours fit to enter decent company.

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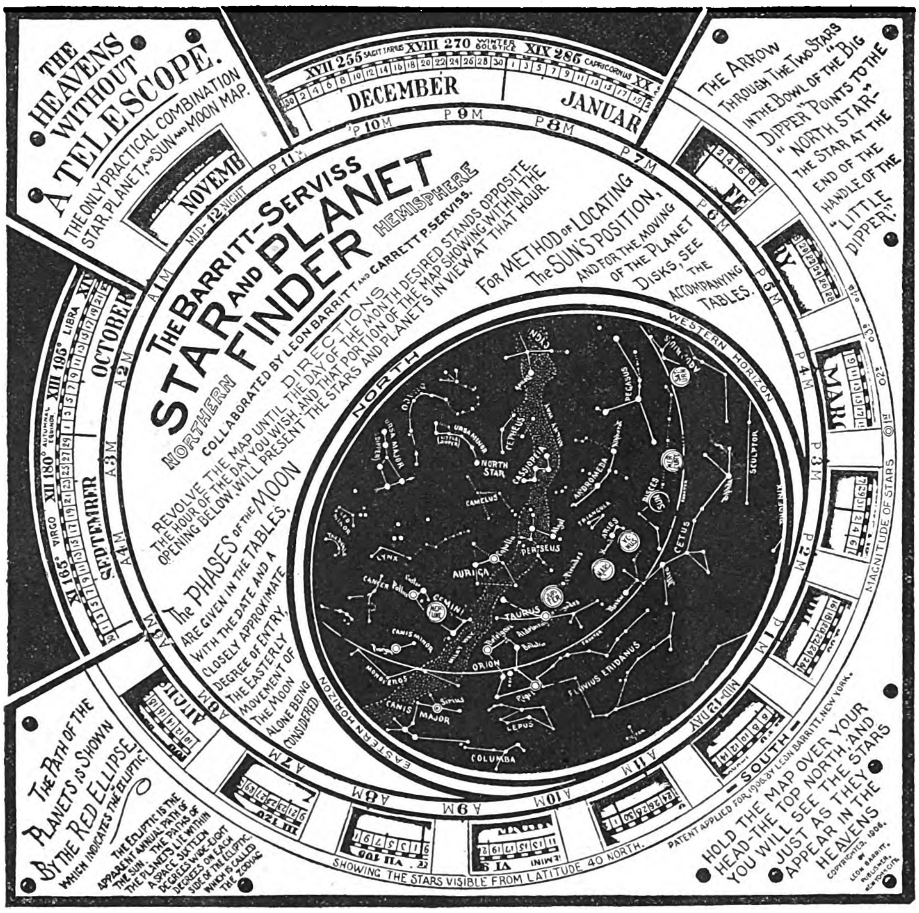
SIR WALTER RALEIGH

Who discovered how good a pipe can be

It's milder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DIRECTIONS
REVOLVE THE MAP UNTIL THE DAY OF THE MONTH DESIRED STANDS OPPOSITE THE HOUR OF THE DAY YOU WISH, AND THAT PORTION OF THE MAP SHOWING WITHIN THE OPENING BELOW, WILL PRESENT THE STARS AND PLANETS IN VIEW AT THAT HOUR.
FOR METHOD OF LOCATING THE SUN'S POSITION, AND FOR THE MOVING OF THE PLANET DISKS, SEE THE ACCOMPANYING TABLES.
THE PHASES OF THE MOON ARE GIVEN IN THE TABLES, WITH THE DATE AND A CLOSELY APPROXIMATE DEGREE OF ENTRY. THE EASTERLY MOVEMENT OF THE MOON ALONE BEING CONSIDERED.
THE ARROW THROUGH THE TWO STARS IN THE BOWL OF THE "BIG DIPPER" POINTS TO THE "NORTH STAR" THE STAR AT THE END OF THE HANDLE OF THE "LITTLE DIPPER".
THE PATH OF THE PLANETS IS SHOWN BY THE RED ELLIPSE WHICH INDICATES THE ECLIPTIC
HOLD THE MAP OVER YOUR HEAD - THE TOP NORTH AND YOU WILL SEE THE STARS JUST AS THEY APPEAR IN THE HEAVENS
SHOWING THE STARS VISIBLE FROM LATITUDE 40 NORTH.
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JANUARY
NOVEMBER
OCTOBER
SEPTEMBER
MARCH
NORTH
SOUTH
WESTERN HORIZON
EASTERN HORIZON
MAGNITUDE OF STARS
NORTH STAR
CASSIOPEIA
PERSEUS
AURIGA
GEMINI
TAURUS
ORION
CANIS MAJOR
LEPUS
COLUMBA
FLUVIUS ERIDANUS
CETUS
PEGASUS
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Current Bulletin Briefs

(*Continued from page 78*)

sumption statistics. Similar reviews available on *Germany* (*Trade Information Bulletin Number 532*) and *England* (*Trade Information Bulletin Number 545.*). *Superintendent of Documents, Government Printing Office, Washington, D. C.—Ten cents each.*

Health and Safety

HEALTH HAZARDS IN CHROMIUM PLATING reports conclusions and recommendations resulting from a recent survey. The report indicates that a real hazard exists in chromium plating, but by the practice of suitable measures, the danger can be entirely eliminated. Specific recommendations are given for counteracting the menace. *Bureau of Standards, Washington, D. C.—Gratis.*

THE VALUE OF INERT GAS AS A PREVENTATIVE OF DUST EXPLOSIONS IN GRINDING EQUIPMENT. Although the investigations were conducted in feed-grinding equipment, the results suggest many possible uses for inert gas as a fire preventive and fire fighting medium. *United States Department of Agriculture, Washington, D. C. —Gratis.*

EMPLOYMENT OF WOMEN AT NIGHT, presents the history of the struggle against the system, with an appeal for better state legislation to regulate night employment of women. *Women's Bureau, Department of Labor, Washington, D. C.—Gratis.*

SPRAY COATING—ITS HAZARDS AND SAFEGUARDS, is a helpful booklet discussing the rapidly expanding lacquer spray industry. The treatise deals with the history of lacquers, health hazards, precautions for safeguarding workers, and steps for the protection of property by various emergency appliances. *Department of Public Relations, Hartford Accident and Indemnity Company, Hartford, Connecticut.—Gratis.*

Mining

COPPER IN 1926, a 57-page general report just published by the Bureau of Mines, is a survey of the entire copper industry in the United States during 1926. Detailed reports are given covering operations in each producing region (including Alaska), and general statistical data on other copper producing countries of the world. *Superintendent of Documents, Government Printing Office, Washington, D. C.—Ten cents.*

GEOPHYSICAL PROSPECTING: SOME ELECTRICAL METHODS (BUREAU OF MINES TECHNICAL PAPER NUMBER 434) contains 34 pages, with many illustrations, describing equipment and proceedure used in connection with methods being practiced in prospecting for ores with electrical apparatus. *Superintendent of Documents, Government Printing Office, Washington, D. C.—Ten cents.*

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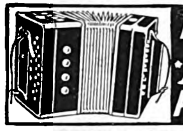

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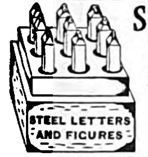

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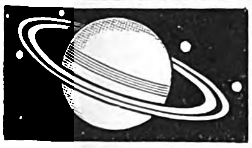

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This bulletin describes two amplifiers admirably adapted to television work. *International Resistance Company, 2006 Chestnut Street, Philadelphia, Pa.—Gratis.*

RADIO ACOUSTIC POSITION FINDING, SPECIAL PUBLICATION NUMBER 146. This 62-page bulletin is illustrated with photographs and drawings showing equipment used in conducting modern coastal surveys. *Superintendent of Documents, Government Printing Office, Washington, D. C.—20 cents each.*

Transportation

RAILWAY STATISTICS OF THE UNITED STATES OF AMERICA FOR 1927, COMPARED WITH THE OFFICIAL REPORTS FOR 1926 AND RECENT STATISTICS OF FOREIGN RAILWAYS, is now available. This 154-page book presents comparative data under many headings including mileage, equipment, employees, capitalization, costs, earnings, expenses, and accidents. *Bureau of Railway News and Statistics, First National Bank Bldg., Chicago, Ill.—Gratis.*

THE EVOLUTION OF MODERN INDUSTRY AND ITS RELATION TO TRANSPORTATION. Reprint of an address by Geo. D. Ogden, Traffic Manager of the Pennsylvania Railroad. In this 18-page paper, the "migration of industry" is discussed, showing effects of railway freight rates, cheap water transportation and shifting centers of population on industries in various sections of the country. *Policyholders Service Bureau, Metropolitan Life Insurance Co., 1 Madison Avenue, New York City.—Gratis.*

Miscellaneous

AIRPORTS AND LANDING FIELDS (AERONAUTICS BULLETIN NO. 5) lists the existing and proposed aviation fields of the United States, as of September 1, 1928. In this 10-page bulletin, landing fields and airports are listed alphabetically by states. *Office of the Secretary, Department of Commerce, Washington, D. C.—Gratis.*

PRACTICAL AIDS TO THE INDEPENDENT MERCHANT. Many of the problems with which the small merchant has to contend are analyzed in this 30-page bulletin, and suggestions for remedying them are given. A list of more comprehensive books and bulletins on Retail Store Problems, Cost and Commodity Studies, Packing and Transportation, Regional Surveys, Commercial Laws, et cetera, is included. *Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C.—Gratis.*

CONCRETE—ITS MANUFACTURE AND USE, is a non-technical treatise on up-to-date methods of preparing and handling Portland cement concrete. *Koehring Company, Milwaukee, Wisconsin.—Gratis.*

RUBBER ROADWAYS is an interesting booklet, well illustrated, showing various methods and materials used in building roads of rubber. *Rubber Roadways, Ltd., 4 Idol Lane, Eastcheap, London, E.C. 3, England.—Gratis.*

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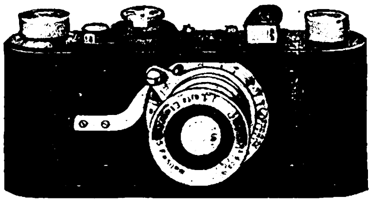

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OPINIONS

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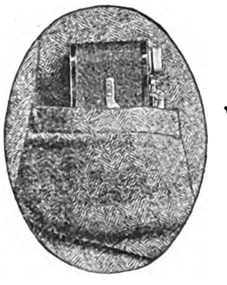

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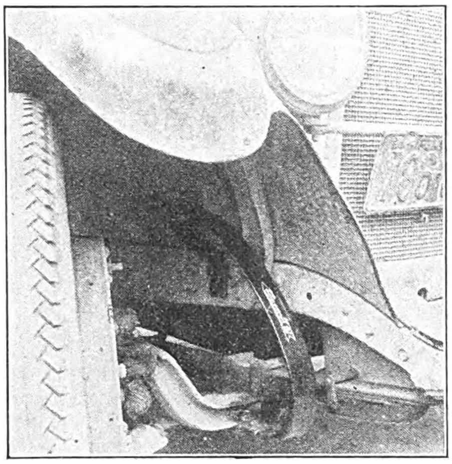
The Scientific American Digest

(*Continued from page* 69)

The tomb was like the queen's in its plan, in its secrecy, and like the queen's in that it tunneled toward the sacred precincts of the temple.

Senmut even went further and dared link his name with that of the ruler of Egypt. On the ceiling of his tomb was written in hieroglyphs a sentence in flowery Egyptian which in plain English contains the idea, "Long live the Queen of Upper and Lower Egypt (Hatshepsut) and the Chancellor, the Steward of Amon, Senmut."



The spring-action damper installed on the front axle of an automobile

But the ambitious architect never had the satisfaction of inhabiting his regal secret tomb. Hatshepsut and her officials were involved in political intrigues which ended in Thutmose III taking Hatshepsut's place as the ruler of Egypt. Senmut's downfall came first, the new excavations show, for his portraits in the tomb are mutilated, while Hatshepsut's are not disturbed.

"As soon as news arrived of the end of the Great Steward, orders were given to close up his presumptuous new tomb," Mr. Winlock states. "Workmen went down to the decorated chamber and smashed the faces of Senmut wherever they noticed them.

"Hastily gathering together bricks and stones at the mouth of the tomb they started to wall it up, but the work did not go fast enough, and before they had finished their wall they gave it up and raked down just enough dirt to cover over the doorway."

When the expedition entered the walled-up tomb, it found only one room had been decorated by Senmut's workmen before the downfall. Walls of the chamber were lined with hieroglyphics. The real gem of the room, however, is the ceiling which represents a chart of the heavens. This is pronounced one of the best and one of the earliest astronomical charts yet found, drawn by the most skilful penmen of the 15th century B.C.—*Science Service.*

Automobile Spring-Action Damper

SHOCK absorbers and spring-control devices of many kinds have been developed in past years in efforts to give cars better riding qualities. A new one that merits consideration because it utilizes an entirely new principle, has just come to our attention. It is the two-way shock absorber, manufactured by Charles M. Kearns, Beavertown, Pennsylvania, which damps the major movements of springs but allows free play of minor movements, during both compression and rebound.

The new absorber consists of a check spring, one end of which is bolted rigidly to the axle frame while the other end rests, in strong tension, on a felt covered bracket which is bolted to the chassis frame. This check-spring makes a sweeping curve outward from the axle, thence upward and back over the bracket.

When the main spring is compressed, the check-spring slides over and backward on the friction mat. Since the check-spring slides over under tension, the friction between it and the mat tends to retard the compression of the main spring.

On the rebound of the main spring, the retarding action is more effective than during compression. This is because the main spring must pull against the strong tension of the check-spring and also because the mat friction is again present.

It is said that these new shock absorbers prevent side-sway.

Electricity Aids in Gassing Fruit Bugs

THE bugs and molds which infest refrigerator cars loaded with fruit will have to wear gas masks soon, if they would escape the effects of a device just placed on the market by the Ansul Chemical Company of California, Modesto, California. This device liberates gas which permeates the skin of the fruit and kills, within 20 minutes, all the larvae, bugs, and various fruit molds that would ordinarily damage the fruit during its shipment east.

Liquid sulfur dioxide is contained in a heavy steel cylinder under high pressure, and the killing gas is mixed with the air of the refrigerator car when a valve is opened in the neck of the container. The high pressure is attained by expansion, the cylinder being placed in a specially prepared container holding three gallons of water at a temperature of 140 degrees, Fahrenheit.

Operator opening the valve of the gas container of the new fruit-bug gassing equipment. The released gas kills all bugs, larvae, et cetera

Some difficulty was at first experienced in attempting to design equipment for generating the heat in the water bath. The problem was finally solved by the use of General Electric immersion heating units.

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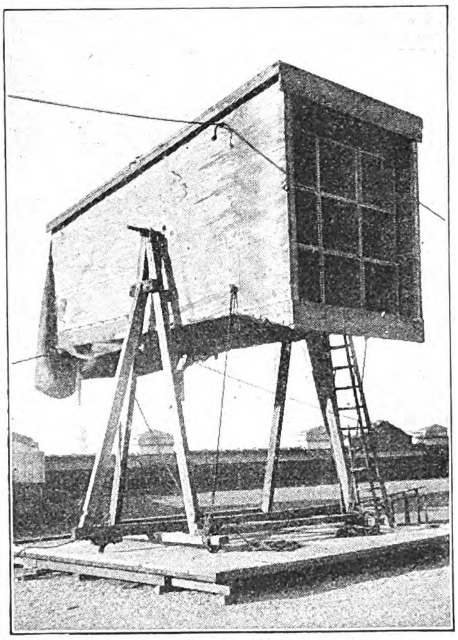
The new unit was recently given its first practical demonstration before a group of fruit shippers on the west coast, and their enthusiastic response is taken as an indication of an intensive campaign of bug and mold extermination soon to begin. California fruit shippers will have this equipment available for use this season to assist them in placing sterile fruits on the eastern markets.

Sound "Beam" Sending Horn

THE practicability of directing a beam of sound to a definite distant point was demonstrated recently when officers of the United States Navy dirigible *J-4*, flying at 1500 feet over Camden, distinctly heard the voices of officials of the Victor Talking Machine Company, as well as a program of music and constant tone signals, projected to them by the recently developed super-directional horn mounted on the roof of a 10-story building at the Victor plant. Instead of the diffusion of waves customary when sound is broadcast, the new horn sent out a beam of sound which at all times was trained on the dirigible in flight, much as the beam of a giant searchlight would have been played on it.



The roughly built but effective, experimental horn for sending a "beam" of sound, on the roof of the Victor Talking Machine building

Satisfactory results of the experiment indicate that an important step has been completed in removing the hazards of landing dirigibles, especially in time of fog, since the horn supplements the work of the radio beacon at a point where, because of short range, the beacon becomes ineffective and useless.

The horn, which was developed by S. T. Williams, Works Manager of the Victor Company, comprises a cluster of nine small-mouthed conical horn units, each carrying a powerful loudspeaker, joined into a single straight-sided mouth without the characteristic musical horn flare. The whole assembly makes up a rectangular box approximately eight feet square and 20 feet long, mounted on pivots and having rotating tracks permitting it to be pointed in any direction. It is expected that further tests will be made in the near future with the *Los Angeles*.

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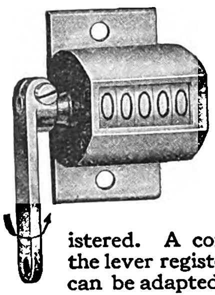

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By Phokion Naoum

AN error of statement was made in our listing of this work last month. The original is of date of 1923 but the translator, E. M. Symmes, has noted any changes or modifications of practice, particularly in the United States, up to 1928. $7.25 postpaid

Old Americans

By Ales Hrdlička

READERS of SCIENTIFIC AMERICAN who have enjoyed the author's articles will be interested in this study of the pioneer white stock in America, including a chapter on the future American type. Anything Dr. Hrdlička writes commands attention throughout the world and this is a particularly important contribution to the question of the mixture of races. $10.00 postpaid

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By Catherine Mackenzie

AFTER eight years of daily association with this robust and picturesque character, the author sets down the story of his life in terms of the work he did and the way he did it. It is not a formal biography but rather a consistent effort to give the facts of a turbulent career which often has been surrounded by misrepresentation and for the most part was a struggle to defend his rights of invention. A most interesting and praiseworthy work. $5.20 postpaid

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By Katherine Helm

THE real story of the life of one of the most misunderstood women in American history, related by her niece from data found in private family correspondence and the diary of Mrs. Lincoln's own sister, Emilie, now released for the first time. Sidelights which present quite a different aspect to her family life than what we have always been given to suppose. $4.20 postpaid

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Its Works and Ways

By Edward W. Warren

JUDGING from the interest in our article on the muskrat and its habits, this book should find favor with all who study wild life, both from a scientific as well as a business viewpoint. Much current mythology about the superhuman intelligence of this remarkable animal is here exploded, although the residue of facts gained from a long and intensive observation is still extraordinary. $3.15 postpaid

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Ideas Are Not Patentable

"THE law grants patents only for new things, not for new ideas."

So declares Judge Swan, of the Circuit Court of Appeals in New York, in the case of the Concrete Mixing and Conveying Company against the Powers-Kennedy Contracting Corporation. It is a remark which might well be memorized by inventors who have new and original ideas they wish to capitalize.

In the case which brought forth the remark of the judge which heads this item, the concrete company's patent included means for injecting air into the concrete at its entrance into the discharge outlet of the conveyor pipe. The Powers-Kennedy Corporation, defending the suit for infringement, maintained that the patent was invalid on the ground that it was anticipated by a system in which the concrete flowed by gravity through the pipe and then was subjected to air or steam pressure. In differentiating the old and new systems, the Court says:

"The physical change in the apparatus need be very little to sustain a patent. The only reason why a new use is not patentable is that the law grants patents only for new things, not for new ideas.

"While this machine discloses the idea of forcing concrete through a pipe by compressed air, whether it was practically operable may well be doubted. It would seem that a large quantity of the concrete, or at least the stones of which it is partly composed, would necessarily accumulate upon the flat bottom of the chamber. In any event, it was very different from McMichael's (the inventor's) device, which injects air into the concrete at its entrance into the discharge outlet. It cannot be regarded as an anticipation."

Profits In Cinders

WHEN notices went out recently to a large number of licensees of various processes for using cinder and ashes in the manufacture of concrete block, asserting that they were violating patent rights of Crozier-Straub, Incorporated, attention was drawn to the quick, widespread and profitable use now being made of a by-product which heretofore has been considered a waste rather than an asset.

The patent in question was issued January 16, 1917, to Francis J. Straub for a building block in which the whole product, cinders and ash, half burned and wholly burned, lumps and dust, were ground and rolled together. Of the merit of the product, Judge Wooley, in the Circuit Court of Appeals for the Third Circuit, says:

"All blocks are more or less soundproof but Straub's is more soundproof than others with hard aggregates, doubtless for the reason that instead of being a solid mass as when made of sand or stone aggregate, it is porous, containing myriads of cells; it permits nails to be driven into it without breaking and firmly holds the nails in place; it is lighter in weight and cheaper to make than any block brought to our attention; although porous and light, it is strong; and, although strong, can be broken on nearly straight lines. With these characteristics its usefulness as a building material, especially in dispensing with the woodwork ordinarily set in the masonry for plastering, and for window-working and door-working, seemed manifest."

With such qualities there developed an unusual demand immediately upon its appearance in the trade. In 1919, the year in which the patentee began seriously to exploit the process, he sold 18,000 blocks. In 1926, he had 77 licensees who sold 24,533,821 blocks. In the span of those years 77,268,792 blocks were made by licensees, and for each block the patent owner received a royalty of three fourths of a cent.

Failure of American inventors to supply a need opens the door to foreigners. In two years a business keeping 17 offices busy has grown around this German "Rotaprint" to make offset lithographs in offices

Naturally, others began to engage in the business without paying a royalty to the owners of the patent. Against Thomas Graham, the Atlantic City Building Block Corporation and others, suits for infringement were brought. Relief was denied them in the Federal District Court but granted in the Circuit Court of Appeals, Judge Wooley declaring:

"Manufacture of the blocks by licensees at widely separated points for local consumption as against mass production at one point for transportation to distant points of consumption is peculiar to the product and is made necessary by the fact that to make a profit the raw material of cinders must be locally available in sufficient quantities and be either free or very cheap. Licenses granted in different trade areas meet this requirement. So at the beginning the licensees obtained their raw cinders from local furnaces for the hauling, but as the demand grew the otherwise free material acquired a money value and now sells at about 15 dollars a carload. In one instance where before the patent it cost the operators of certain furnaces from 7000 dollars to 9000 dollars a year to remove cinders, they now have an annual profit of 15,000 dollars from the sale of cinders for use in the Straub block.

"For 50 years inventors in the cement art have given the subject of cinder aggregates a considerable amount of attention. It does not show, however, that their inventions made any distinctive impression upon the building art. On the contrary it proves that it was not until Straub's invention that the trade turned to blocks with cinder aggregates.

"Hence we must read the Straub invention in the light of the many prior patents and publications. A study of these has convinced us that our decision in the Campbell case, whether by accident or otherwise, was right. It shows that prior inventors and writers had for half a century, indeed from the very beginning of the Portland cement industry, regarded cinders as an aggregate in cement mixtures and had dealt with them in a great number of combinations and proportions and that they had hit upon nearly everything except that which Straub hit upon and had practically surrounded him, yet, we think, without touching him. In some instances they came pretty close, indeed very close, but missed.

"This very activity in a rapidly expanding art indicates to our mind that if all the others failed to see what Straub saw, then Straub saw something new; and the fact that he saw it through a maze of inventions and publications which others failed to penetrate argues for invention. Moreover, the fact that, since our decision sustaining the patent, Straub's conception has founded a great industry while the conceptions of others resulted only in desultory and sporadic activities, indicates the great usefulness of Straub's invention and justifies our previous finding."

Protecting Your Personal Name

CAN a man recover damages if an author or publisher mentions him in a book without his consent? That may depend to some extent upon the particular state in which action is brought, but in New York, at least—and New York is more or less the publishing center of the country—there can be no recovery for the mere use of the name within proper limits and by way of giving local color to the work.

This was made clear when Edna Ferber, novelist, and Doubleday, Doran and Company, publishers of "Show Boat," succeeded in having dismissed a suit for 25,000 dollars damages brought by Wayne Damron, of Catlettsburg, Kentucky. His name, he declared, was used in the book without his permission "for purposes of trade," which is prohibited by the Civil Rights law. In one chapter of the book "Big Wayne" and "Little Wayne Damron" are referred to as owners of a saloon.

In dismissing the action, Justice Gavegan, of the New York Supreme Court, said: "It goes without saying that literary expediency may not be advanced as an excuse for violating the statute. It is well established that every incidental mention of some person's name in connection with advertising or trade does not constitute a violation of the provisions under consideration. The single appearance of plaintiff's name in this book is clearly not a use prohibited by the statute. It would impose uncalled for burden and hazard were we to hold that publishers and booksellers could not lawfully publish or deal in books without the production of genuine, written consent, from every one mentioned even once, or that an author could not lawfully mention any one without like consent."

Radios Are Not Machines

In New York there has been on the statute books since 1922 a law making it a penal offense to remove the manufacturer's serial number from a mechanical instrument. Recently the first arrest was made under it, and the result was merely to narrow the interpretation of the measure.

A representative of the Grigsby-Grunow Manufacturing Company, makers of Majestic radio sets, appeared as complainant against Isaac Greenberg, proprietor of a radio store, charging that Greenberg had several radio sets in his place from which the serial numbers had been removed, thus making it impossible to trace the person to whom the sets originally had been sold. Greenberg refused to give any explanation for the removal of the numbers.

Magistrate Bushel dismissed the case, holding that a radio set is not a mechanical instrument.

Ear Marks of Invention

For many years it has been a practice of cattle raisers to identify their stock by means of ear tags. An ear tag consists of a metal strip with a point and sharpened prong at one end and a slot across the other end. The strip is bent into a loop and the prong passed through the ear and through the slot and clinched first inwardly toward the bend of the loop and then backwardly to form a return bend.

From users of such ear tags arose frequent complaints that after the tags were affixed to the cattle's ears, they would catch in brush or wire fencing and would work loose or be torn out. After considerable study, Edwin F. Hennefer patented an ear tag which provided a second hole or slot into which the bent over end of the prong was forced by the pliers in fastening the ear tag to the ear of the animal. After Hennefer's employers, the Jensen-Salsber Laboratories, put this new type of tag on the market, there were no more complaints. It was not long before a rival manufacturer, the Salt Lake Stamp Company, placed a similar tag on the market. Jensen-Salsber sued for infringement.

"The very simplicity of Hennefer's accomplishment creates at first an impression that Hennefer's improvement involved mechanical skill, rather than invention, but simplicity alone is not a reliable test," Judge Sanborn, of the Eighth Circuit Court of Appeals, finds.

Quoting Supreme Court Justice Taft, he says:

"'Indeed, when one notes the crude working of machines of famous pioneer inventions and discoveries, and compares them with the modern machines and processes exemplifying the principle of the pioneer discovery, one hesitates in the division of credit between the original inventor and the improvers; and certainly finds no reason to withhold from the really meritorious improver, the application of the rule, *'ut res magis valeat quam pereat,'* which has been sustained in so many cases in this court.'"

Resuming his discussion of the ear tag, he concludes,

"Ear tags are old. The desirability of a tag such as Hennefer produced must have been apparent for many years, and yet he was the first to make it.

"The question as to whether this improvement of Hennefer's rose to the dignity of invention is a doubtful one, but the burden was upon the defendant to show that it did not. There was evidence to justify a conclusion that it was a substantial contribution to the art, that it solved a problem which had been under consideration for some time, in an effective and economical way, and that there had been a real demand and need for it. We have reached the conclusion that the trial judge, upon the evidence before him, was justified in holding the patent in suit to be valid."

Patents Seized in the War

For ten years the status of the 12,000 enemy-owned patents seized by the United States in the World War has been in doubt. Now at last it is finally settled by the War Claims Arbiter, Judge Edwin B. Parker. He denies to former enemy claimants the right to recover compensation for more than 5000 patents acquired by the United States from the Chemical Foundation, Incorporated, which had purchased them from the Alien Property Custodian at a private sale. The rules and principles Judge Parker announces will govern the preparation, presentation, and decision of claims based on all the patents seized in the War by the Government.

Federal Trade Commission licenses, he holds further, do not come within the terms of the War Claims Settlement Act. He denies the right of numerous claimants for compensation for alleged use by the United States of trademarks owned by the claimants, saying that obviously the United States Government has not pirated any trademark.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

Airship—Having a container for gas, a boat-shaped cabin swung from the container, and a plurality of sets of wings projecting laterally on both sides of the container. Patent 1685458. Leonard P. Lidback, 574 Beretania St., Honolulu, Territory of Hawaii.

Propeller—Of open construction, in which the active propeller blades are arranged at a distance from the hub, and supported by rods which offer little resistances to the air. Patent 1686214. Royal N. Kyle, Box 36, Gardnerville, Neb.

Chemical Processes

Cleaning Composition of Matter—Which is particularly adapted for cleaning and polishing silver, and consists of diatomaceous earth, calcium chloride, ferric oxide, ammonia, oil of citronella and water. Patent 1685360. Robert B. Hoffman, c/o Monterey Products Co., Monterey, Calif.

Designs

Design for a Sign—Patent 76385. J. F. Fisher, Box 3263, Honolulu, Territory of Hawaii.

Design for a Combined Toothpick and Dental Floss Holder—Patent 76490. Ernest T. Lutz, c/o Mrs. M. Finnegan, Beloit, Kans.

Design for a Doll—Patent 76631. Laulie S. Newell and Cora E. Brown, c/o Welsh, Beckham, Farley & Ellis, Olympia Bldg., Miami, Fla.

Design for a Door—Patent 76494. James A. Pietsch, 101 Cebra Ave., Stapleton, S. I., N. Y.

Design for a Stocking—Patent 76448. Louis D. Barish, 61 W. 9th St., New York, N. Y.

Design for a Smoker's Ash Receptacle or Similar Article—Patent 76625. Angelo J. Mornaghini, 3109 Tilden Ave., Brooklyn, N. Y.

Design for an Escutcheon—Patent 76452. R. E. Bletcher and E. H. Bucknell, 3011 Humboldt St., Los Angeles, Cal.

Design for a Globe-Holding Electric Fixture—Patents 76555 and 76556. Morris Schlepp, c/o Sterling Spinning & Stamping Works, 476 Broome St., New York, N. Y.

Design for a Dish or Similar Article—Patents 76536 and 76537. William P. Graham, c/o Graham & Zenger Co., 104 5th Ave., New York, N. Y.

Design for a Coat—Patent 76522. Katherine E. Burns, c/o Franklin Simon Co., 38th St. & 5th Ave., New York, N. Y.

Design for a Weather Vane—Patent 76316. E. W. Lawson, 509 "O" St., West Palm Beach, Fla.

Electrical Devices

Transformer—So wound that its magnetic field is confined to a restricted area, so that in close proximity, as in a radio circuit for example, overlapping is prevented. Patent 1687973. Francis De Willy, 2164 Montana St., Los Angeles, Calif.

Voltage-Testing Apparatus—To be incorporated with a radio receiver to permit the testing of important elements from time to time, To the extent that the inventions disclosed by the patents acquired by the Foundation were used either by or for the government of the United States itself, prior to the date of the sale and assignment to the Foundation, the United States must, under the Act of 1928, compensate the former German owners for such use. The Arbiter holds that "this includes all use by or for the United States from August 1, 1914, to April 5, 1917, both dates inclusive, and from November 12, 1918, to (but not including) the date of the sale and assignment of the particular patent by the Custodian to the Foundation."

An Outside Inventor

IF you are seeking a field in which to exercise your talent for invention, you will be more likely to succeed if you select one about which you know something. This is especially true if your invention is an improvement or an attachment, rather than a device of a pioneer nature. A dentist is more likely to produce a practical, profitable invention in the line of dentistry than in the line of radio, just as a radio expert would be more likely to make money out of a radio receiving set than out of a dental plate.

Consider the experience of Percy Osteen, of Anderson, South Carolina. Osteen was a barber in 1916, when he saw a need for an improvement in cameras. The patent he obtained related to folding cameras of the familiar type adapted to take photographs upon a film rolled upon reels mounted within the casing of the camera and fed from the supply reel to the take-up reel step by step as the pictures are taken. Like many another amateur snapshotter, he came to realize that if the film were not advanced after operating the shutter before another picture was taken, two exposures would be made upon the same section of film. He obtained a patent on a method which Judge A. N. Hand, of the Circuit Court of Appeals for the Second Circuit, describes as follows:

"Osteen, the patentee in this case, sought to apply an automatic wind for the film under the control of the shutter to a folding camera. He proposed to use a spring motor for feeding the film as had long before been done in box cameras, and proposed an operating connection between shutter and motor as others had done before.

"But not only was the application of these ideas to box cameras well known, but when attempting to apply them to folding cameras he entered a field already crowded. When Osteen attempted to apply these old elements to a folding camera, he had to make some provision for folding the parts connecting the shutter and motor when the hinged front of the camera was pivoted into a closed position."

Having his patent, Osteen sued Ansco Photoproducts, Inc., for infringement of his patent. He won a decree in the District Court, but this was reversed by the Circuit Court, it being shown that many devices had previously been patented for the same purpose. To avoid this prior art he had to confine himself practically to the structure specifically disclosed in his patent. But if he did that, the Ansco Company was not infringing.

Of the merit of his invention, Judge Hand says:

"It is moreover to be noted that no cameras have ever been manufactured under plaintiff's patent and he seems to have shown no adequate experience in such matters. He testified that when he took out the patent he was in the 'barber business' and at the time of the trial was 'in the theater business.' The device which he made in 1915, he testified, was not made in accordance with the drawings of his patent. It is quite unlikely that a man with such experience could have contributed a meritorious invention to a technical and complicated art, and, at least so far as the claim in suit is concerned, there would seem to be no evidence that he ever did."

to determine whether the voltage is of required value. Patent 1686451. John W. Hill, 326 E. 7 South St., Salt Lake City, Utah.

MAGNETIC - LOCK - OPERATING DEVICE—For unlocking and locking spring actuated doors of small home savings banks, the special magnetic key being in the custody of the institution issuing the bank. Patent 1686202. Carl W. Cherry, Box 863, Carmel, Calif.

ELECTRICAL COMPOUND LETTER—For electrical signs, wherein all letters of the alphabet, numbers and other configurations may be produced by causing different groups of lights to be lighted. Patent 1688266. Bradford D. Coffey, 693 Bergen Ave., Jersey City, N. J.

Of Interest to Farmers

ADJUSTABLE PLOW AND SHOVEL—Which has novel means for holding the shovel in adjusted position yet permitting the shovel to swing should it strike a stone or the like. Patent 1686961. James T. Davenport, 127 So. Prairie St., Galesburg, Ill.

Of General Interest

RAZOR-STROPPING DEVICE—In which the blade holder operates to prevent the edge of the blade from cutting the strop, or being injured by its engagement with the strop. Patent 1685470. Charles L. Van Amburgh, 333 Dayman St., Long Beach, Calif.

WEATHER SHIELD FOR WINDOWS—Designed for preventing the entrance of drafts, dust, rain or insects, between the sashes and frames adjacent the parting strip. Patent 1687392. Evelyn O. Schaffert, 19302 120 Ave., St. Albans, L. I., N. Y.

MEANS FOR MOULDING RUBBER DRAINING BOARDS FOR SINKS—That they may be so formed of resilient material as to prevent or minimize the unsanitary conditions of moist wood boards. Patent 1688232. James P. Harkin, c/o Collison & Co., 483 Collins St., Melbourne, Australia.

WALL HOOK—For supporting a picture or mirror, a washer in connection with the hook supporting and reinforcing the plaster under and around the nail. Patent 1687413. Carl J. Witt, Caixa 2947, Sao Paulo, Brazil.

SAFETY DEPOSIT VAULT—Which is located under the ground and protected by the ground and the structure itself, secured against the action of the elements and unauthorized removal. Patent 1687431. Charles N. Dilatush, R.R. No. 4, Lebanon, Ohio.

STENOGAUGE—For use by stenographers and typists to ascertain the position of the carriage of a typewriter at the beginning of writing a caption and centering the same. Patent 1687429. Roy G. Datson, c/o Pyramid Packing Co., 375 Coleman Bldg., Seattle, Wash.

FILING STRUCTURE—For use in filing data pertaining to real estate or similar transactions, wherein the cards are partially locked in place for vertical filing and unobstructed observation. Patent 1685448. Thomas C. Butterworth, Box 866, Mill Valley, Calif.

HOME SAVINGS BANK—Of the small type issued by banking institutions, proof against being opened except through special means in the custody of the institution only. Patent 1686201. Carl W. Cherry, Box 863, Carmel, Calif.

COMBINATION DOOR STOP AND HOLDER—Which is rigidly attached to the floor, and includes a buffer for stopping the door, and a catch for holding the door in open position. Patent 1688221. Charles J. Abbey, 116 Madison Ave., Skowhegan, Me.

SPRING-PRESSURE BUTTON—Which assures a reliable fastening for fabrics, while its two component parts may be readily separated without strain upon the attaching means. Patent 1688272. Louis Fouletier, c/o C. Bletry, 2 Boulevard de Strasbourg, Paris, France.

Unauthorized Selling Is Not Trademark Infringement

TRADEMARK registration has its limitations. You cannot, for example, construe the use of your mark by an unauthorized dealer as an act of infringement, provided the goods he sells are the genuine article.

This was made clear recently when the Gotham Silk Hosiery Company, Inc., tried in vain to enjoin Arthur and Joseph Goldstein, small retailers, from selling the well known "Gotham Gold Stripe" hosiery. The Goldsteins had had no dealings with the Gotham Company, but had bought Gotham stockings from other dealers and advertised them for sale at prices below those of authorized Gotham dealers.

The Gotham Company does not sell to retailers generally or to jobbers, but through its own retail stores and dealers of its own selection. To retail purchasers it grants the privilege of returning its stockings for repair at nominal cost, for redyeing, for exchange or for cash or credit if defective. It attributes its success in part to these methods and upon them it bases a retail price which it "suggests" to dealers. When the Goldsteins began advertising and selling Gotham hosiery, the Gotham Company sought an injunction, maintaining that they were holding themselves out as authorized Gotham dealers.

Judge Thacker, of the Federal District Court for Southern New York, finds, however:

"The natural inference to be drawn from the fact that the product is offered at cut rates and from the defendant's evident purpose to create the impression that he was underselling the regular Gotham dealers, is that he did not hold himself out as a regular dealer, and I accept his denial of any such representation as more credible than the testimony of interested witnesses to the contrary. So far as the use of the trademarks is concerned, they were used only in connection with the advertising and sale of genuine "Gotham Gold Stripe" Stockings and there was consequently no infringement.

"Their use on paper bags in which all kinds of merchandise was wrapped for customers was merely advertising, and not intended to falsely mark the goods contained in the bag. This is clear from the evidence that the stockings were not sold in the bags and that purchasers were told what they were buying before their purchases were put in the bags. Nor was the use of genuine Gotham labels on boxes in which the defendant kept genuine Gotham stockings on his shelves infringement of the trademarks. In all this there was neither attempt to deceive or to palm off spurious goods, nor was there any confusion of goods whatsoever."

Bookstand—Which will conveniently support any desired number of books, such as telephone books, or binders carrying the books, and enable each book to be swung into position for use, and when not in use swung back into the casing. The inventor has been granted two patents 1687443 and 1687444. Walter E. Haskin, c/o Pressed and Welded Steel Products Co., 326 Boulevard, Long Island City, N. Y.

Display Device for Screens—Which will support screen doors or other screens so that they may be easily displayed and a relatively large number located in a small space. Patent 1688255. Louis Wasch, 1139 E. Mahanoy City, Pa.

Holder for Ledger Sheets—For retaining a plurality of sheets, for example, a ledger sheet and a depositor's statement, during the various manipulations of posting or filing bank balances. Patent 1688264. John C. Carpenter, c/o The Oswego Democrat, Oswego, Kansas.

Hardware and Tools

Rotary Reamer—Formed with reversible cutting edges, both of which may be used before the shoe is renewed or re-sharpened, and may be readily replaced when dulled. Patent 168403. Alexander Boynton, 1800 San Pedro Ave, San Antonio, Texas.

Driver Chuck—A tool adapted for screwing the nut of a flexible stay bolt onto the bolt in the socket, or removing the nut from the bolt and socket. Patent 1686412. Harry A. Lacerda, 1427 5th Ave., Watervliet, N. Y.

Lock—Of the spring pressed bolt, or "night latch" type, which is practically immune from outside forcing, but may be freely operated with the proper key. Patent 1687388. Jorge Rigo, Reyes 89, Vibora, Habana, Cuba.

Heating and Lighting

Combination Gas and Oil Burner—Including a circular series of gas nozzles, an oil burner located centrally, and an air casing around the gas nozzles with means for controlling the air. Patent 1687390. Eugene Ritter, Box 981, Monroe, La.

Liquid-Fuel Burner—Wherein air under pressure is eliminated, but which utilizes atmospheric pressure which is admitted to the burner in proportion to the liquid fuel supply thus reducing fuel consumption. Patent 1687386. John H. Reeve, 434 Larrabee St., Portland, Ore.

Musical Devices

Musical Instrument—A construction for head instruments, wherein is presented a rim and bottom for supporting a diaphragm so that the sound produced may pass from both sides. Patent 1685706. F. Gretsch, 60 Broadway, Brooklyn, N. Y.

Apparatus for Teaching Sight Singing—Which may be conveniently manipulated by a teacher to display musical notes on a staff board, where large groups of students are to be handled at one time. Patent 1685682. M. B. Rock, 314 Rockland Ave., West Brighton, S. I., N. Y.

Musical-Instrument Stand—Which can readily be collapsed, and is particularly adapted for holding banjos and like instruments when not in use, to prevent accidental knocking over. Patent 1684912. C. T. Dunklau, 138 E. 104 St., Los Angeles, Cal.

Machines and Mechanical Devices

Screen Cleaner—For cleaning screens through which a spraying mixture of paint, or like substance is forced, the particles in suspension being removed by an oscilliating brush. Patent 1687428. Levin O. Corkran, Chesterfield Farm, Rhodesdale, Md.

Burglar Alarm—So arranged that a burglar or, unauthorized person, cannot enter an open window or door, or force a closed one, without sounding a signal. Patent 1686457. Thaddeus S. McClintock,923 Timberlands Ave., Pittsburgh, Pa.

Machine for Casting Stereotype Plates—In which the frame is supported by the furnace walls by eccentric bushes, and is standardized for all sizes of newspapers. Patent 1686429. Carl Winkler, Bern, Switzerland.

Shoe Rack—A simple and compact device with movable rollers for supporting and conveying a plurality of shoes in any formative stage through a factory. Patent 1687397. Charles E. Shively, 1125 8th St., Portsmouth, Ohio.

Method of and Apparatus for Cementing Oil, Gas, and Water Wells—Which makes it possible to introduce cement down through the well casing between plugs, and hold the plugs in position until the cement sets. Patent 1687424. Alexander Boynton, 1800 San Pedro Ave., San Antonio, Texas.

Process of Forming Pipe Closures—In which a plug having a circumferential groove and flange, is inserted into a red hot pipe end and the pipe bent into the groove and welded. Patent 1686562. Percy Jackson, P.O. Box 1551, Cincinnati, Ohio.

Film Magazine—Particularly designed to accommodate "spool films" as used in motion picture photography, mechanism being provided for sealing the magazine against the entry of light to the film. Patent 1686204. Byron V. Covert, Lockport, N. Y.

Flush-Valve Mechanism—In which the liquid-tight sealing of the outlet port is positively effected with each closing of the valve, thus eliminating water waste. Patent 1686932. Morris Schiller, 830 Milwood Ave., Venice, Calif.

Testing or Demonstrating Apparatus—For testing the rolling qualities of spherical objects, such as golf balls, or other objects which are depended upon for interbalance and rolling accuracy. Patent 1688274. Bryce Haynes, 1 Sheridan Sq., New York, N. Y.

Advertising Device for Dispensing Machines—The advertising matter being operable to attract attention in response to the operation of a manipulator forming a part of the machine. Patent 1688278. John E. Kenkel, Great Falls, Montana.

Liquid-Supply Tank—Having a float valve for controlling the supply of liquid from one reservoir to another, so that a predetermined volume will be at all times contained in both. Patent 1688279. William S. Locke, c/o Portland Realty & Trust Co., 214 Railway Exchange Bldg., Portland, Ore.

Machine for Rounding Gear Wheels—A hand operated instrument which will accurately true up a gear wheel so that all the openings between the teeth will be of the same depth. Patent 1688243. Jesus L. Limeres, c/o Augustus Pacette, Calle Pasco 27, Habana, Cuba.

Multiplication Device — Comprising a plurality of movable elements, by which any number can be multiplied by any one of the digits and the correct product obtained. Patent 1687182. Kurt Seifert, P.O. Box 621, Los Angeles, Calif.

Prime Movers and Their Accessories

Fuel-Mixing and Supercharging Device—For controlling and regulating the flow of air and liquid fuel, mixing the two together, atomizing the resulting mixture, and forcing the same into an intake. Patent 1686413. Philip J. Laronde, R.F.D. 9, No. River Road, Manchester, N. H.

Internal - Combustion Motor—So constructed that the connection between the crank shaft and piston rod compensates for wear and insures a silent and effective operating engagement at all times. Patent 1687425. Henry Briggs, 244 Walter Ave., Hasbrouck Heights, N. J.

Railways and Their Accessories

Rail Joint—In the form of a splice or fish plate, which affords facilities for connecting the meeting ends of rails so that they will be held against displacement. Patent 1685704. A. L. Collins, Sr., Box 363, Amite, La.

Reflector—Designed to reflect a portion of the main light beam of the locomotive headlight for illuminating the foot board or steps of the locomotive. Patent 1686476. Damon E. Stinson, 309 Holladay Ave., Portland, Ore.

Pertaining to Recreation

Game Apparatus—Having a wide range of utility for educational and amusement purposes, both facilitating the teaching of spelling to children, and an amusement to persons of all ages. Patent 1685723. M. J. Robins, Florena Nightingale School, Katonah, N. Y.

Wheeled Toy Vehicle—of the so-called "scooter" type of wheel coaster, having a platform with a box body forwardly thereof, leaving a standing platform in the rear. Patent 1686427. Paul T. Wallgren, 5237 No. Sawyer Ave., Chicago, Ill.

Pertaining to Vehicles

Brake—Which facilitates the making use of a suitable liquid or air, to expand a braking member to frictionally contact with an associated brake drum. Patent 1685709. A. E. Lee, 255 Shawnee Path, Akron, Ohio.

Luggage Carrier—Attachable to an automobile, and is adapted to have a relatively great carrying capacity when extended, and to take up but little space when folded. Patent 1686450. William Henry, 1225 Greenwood Ave., Rockford, Ill.

Testing Device for Valves—A tire valve tester which embodies the use of liquid into which air escaping is caused to form bubbles thus visibly indicating a leak. Patent 1685454. Carl Johnson, 727 W. 53 St., Los Angeles, Calif.

Dirigible Headlight—Which imparts in a smooth and easy manner the movement of the headlights when the automobile is steered, and takes up within itself vibration. Patent 1686459. Fred McKenney, c/o John S. Winkle, Volunteer Life Bldg., Chattanoogo, Tenn.

Autosleigh—With means for facilitating travel of the vehicle over snow and ice covered surfaces, certain of the runners being attachable to the vehicle and others to the wheels. Patent 1687455. Francis A. Klein, 920 2nd St., Xenia, Ohio.

Direction-Indicating Signal—Consisting of a casing containing a tubular expansible and contractible member, projected and withdrawn by air pressure, the driver readily controlling the air flow. Patent 1685330. John M. Maroney, 601 Hobart St., Oakland, Calif.

Adjustable Vehicle Seat—Which may be quickly adjusted horizontally toward or away from the steering wheel, or vertically, and the seat or back tilted, to suit a driver's requirements. Patent 1685770. Richard E. Bowen, 1748 Rimpan Blvd., Los Angeles, Calif.

Dirigible Spotlight—Associated with the steering mechanism, to direct the light rays so that the edge of the road will at all times be visible to the driver. Patent 1687173. Boyd F. Miller, Box 80, Eldridge, Calif.

Aquatic Vehicle—For supporting a person in either a seated or swimming position, the lower body being submerged, the vehicle embodying means whereby the person may propel it. Patent 1687194. James F. Caldwell, Box 121, Watts, Calif.

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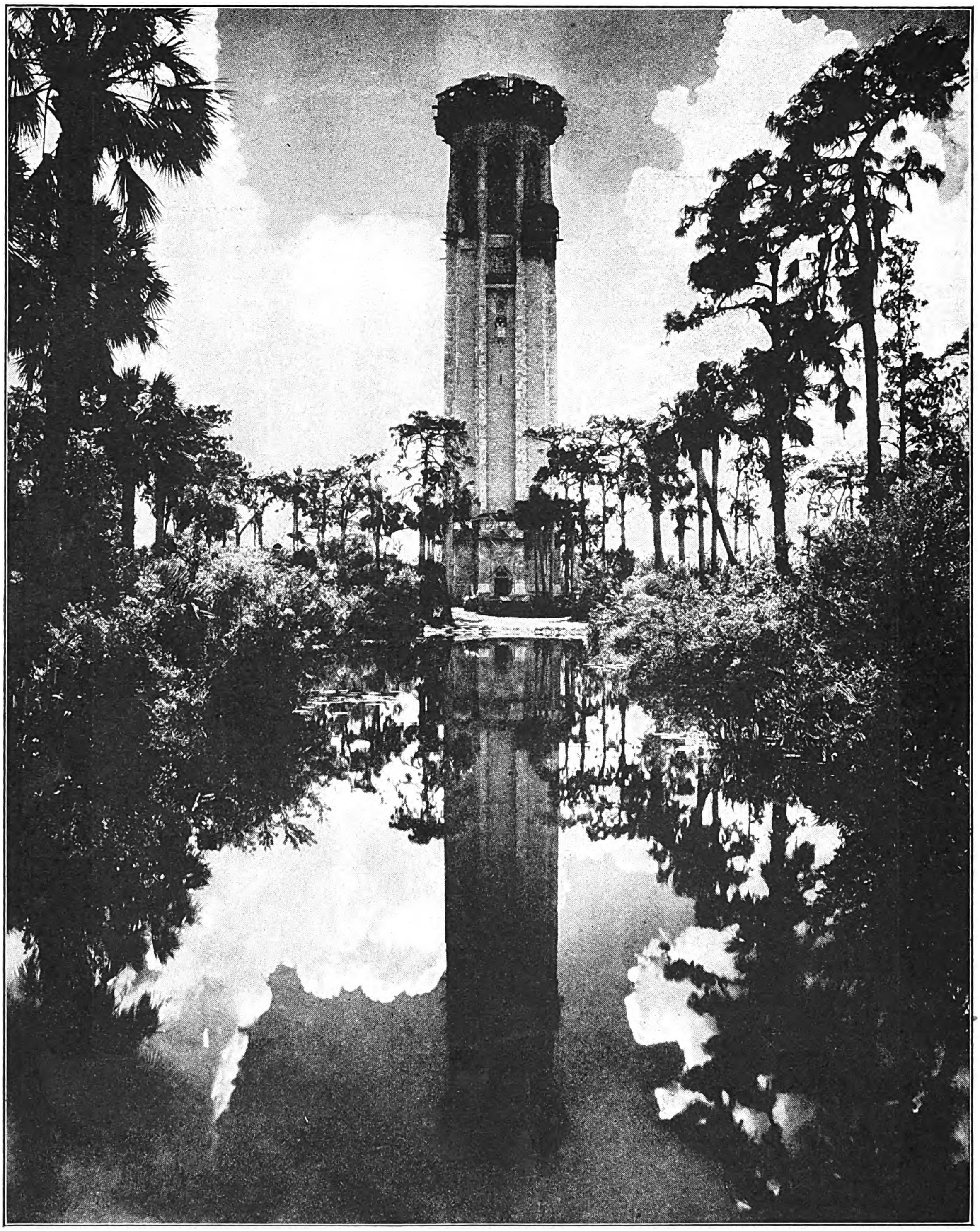
Dr. Annie J. Cannon

DR. ANNIE J. CANNON of the Harvard Observatory is the curator of the largest and most valuable collection of astronomical photographs in the world. She is, in addition, recognized as the most eminent woman astronomer. Her contributions to knowledge during the last 30 years have related to the variations of stars, their distribution in space, and above all to their classification. Her work in the classification of a quarter of a million stars, published in the famous nine-volume Henry Draper Catalogue of the Harvard Observatory, has brought her international fame and high honor in many countries, including honorary degrees from Oxford, Gröningen, Wellesley, and the university of her native state, Delaware. As curator of astronomical photographs at Harvard she has supervision of a collection of more than 300,000 glass negatives, made during the past 40 years with many telescopes at Harvard observing stations in the northern and southern hemispheres. The collection is in continuous use in the Observatory's studies of the classes, variation, and motions of stars, the distance of clusters and nebulae, the size of our Galaxy, and the distribution of those faint external Galaxies that lie out toward the remote boundaries of the universe



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In the beautiful wild life sanctuary at Mountain Lake, Florida, is situated a unique combination of Old World beauty and modern utility. This is the "Singing Tower," built and given to the state by E. W. Bok. Located on Iron Mountain, the highest point of land in Florida, the tower rises 205 feet above its base. Placed within the tower at various heights are the bells of a huge carillon—61 of them. On the top of the tower is to be placed a powerful beacon, as such a high point in an otherwise low, flat territory would, if unlighted, be a menace to increasing aerial traffic. Beacons of this sort, properly located and tended, are an increasing necessity, and this one reflects the foresight of its donor. (See also page 122.)

ABOUT TO EXECUTE A "KAIAK SPIN"

In these light, bouyant, skin-covered boats, Eskimo boys and men take great delight in turning over and over in the water. A water-proof jacket lashed to the boat gunwale and the wrists prevents water entering the covered craft

The Clean and Honest Eskimos

In Honesty, Truthfulness and Friendliness the "Inuits" of the Arctic Circle Are at Least the Equal of the Civilized White Man

By DONALD A. CADZOW

MY first meeting with the Eskimo was in the fall of 1911, at Rampart House in the northern part of Alaska. My idea of an Eskimo up to that time probably coincided with the average person's conception of these interesting Arctic dwellers. I had not heard that the Eskimos came to Rampart for trade, and when several families of them came in over the mountains from the north, I mistook them for unusually clean and cheerful Indians. They were not at all like my imaginary Eskimo, who was short, fat, and greasy; constantly chewing on a piece of raw blubber. They were big, clean, and very friendly.

TOOL-A-WAK, or "Crooked Arm," was their leader, chosen because of his slight knowledge of the English language. In a few days Tool-a-wak and I became fast friends, and during the five years that I lived in the western Arctic, he and his wife considered it their duty, as my friends, to see that I was properly supplied with skin clothing every fall.

In my wanderings above the Circle, Tool-a-wak's igloo, wherever it might be, was my home. He and another Eskimo, named Koo-ru-guk, were my companions on many weary miles of trail over the frozen tundra.

Since I left the friendly shelter of Tool-a-wak's little snow house in northern Alaska, I have visited many of his people in Arctic America, as far east as Baffin Land, for the purpose of studying their life and customs. And, as a race, I have found them to be a most interesting group of people, about whom very few authentic facts are really known by the general public.

Just how many Eskimos we have on the North American continent is not known. We do know, however, that there are about 25,000 of them scattered along the 5000 miles of Arctic coastline. As a rule, most people consider them as sort of an Arctic Indian, whereas the name Indian, although it is the common designation for all the natives of America, is not intended to include the Eskimo. The two races have nothing in common. Up to the time white men ventured into the far North to trade for fur, they were at war. To this day they do not trust one another in any of the regions I have visited.

SLEEP OF THE JUST

Eskimo babies, naked, are carried under the mothers' hood next to her skin. Here baby sleeps as mother works

THEY do not like to be called Eskimos, for in most places they do not know what it means. They prefer to be known as Inuits, which in their language means "people."

The name Eskimo (in the form Excominquois) seems to have been first given to them by a man named Baird in 1611. It comes from the language of a tribe of Indians known as Abnaki, who lived in the region now occupied by the state of Maine. It is a corruption of the word Esquimantiac, meaning "eaters of raw flesh." The name really is quite appropriate even today, as most of the Eskimos prefer certain foods raw and frozen rather than cooked.

They vary in size in different localities. In Alaska, as a general rule, however, they are fairly large in stature, men and women averaging about five feet, six inches in height. In Greenland and on the coast of Labrador I have found them to be much smaller, but otherwise the same people, speaking the same language, with only a slight difference in dialect. The skin of the Eskimo is light colored with a ruddy tint; their hands and feet are small and well formed. Their eyes have a Mongoloid character which might indicate Asiatic origin. But to day, no scientific evidence has been brought forward to prove that they came from Asia.

Explorers have used the Eskimo's mode of existence to carry on their work, and today many objects invented by them cannot be improved upon by white men. One of these inventions is the stone lamp, used in the igloos and tupiks for heating and lighting. They have been possessed by the Eskimo from time immemorial, and they are the only aborigines of this hemisphere who had such utensils. The Etruscans on the Mediterranean Sea are the only other primitive people who are credited with the invention, and their country is a far cry from the Arctic. The Eskimos have always been, and still are, utterly dependent upon their lamps for existence, for with no fat or oil in the snow houses in winter to feed the lamps, the Eskimo will freeze to death. Moss mixed with oil rendered from animal fat is burned in the lamps.

IN southern Alaska the lamps have a narrow wick edge and are shaped like a flat-iron. In other sections they are made of clay, feathers, and seal blood mixed together, shaped like a saucer, and hardened in the sun. In the northern part of Alaska and all along the Arctic coast to Greenland they are made of soapstone in various forms. The length of the wick edge of these lamps has been observed to vary with latitude, that is, the higher the latitude, the longer the night, hence the greater need for light, which is met by lengthening the margin of the lamp on which the moss wick is placed.

The snow houses in which the Eskimos live in winter are marvels of engineering, and in building them of blocks of snow, the principle of arch construction is used. The only other use in the world of this arch by primitive people was by the Etruscans. In early times, as proved by recent archeological research, the Eskimos lived in winter in houses dug out of the ground. The sides of these houses were built up with walls of sod and stone and the roof was covered with whale ribs upon which skins probably were placed.

Then came the invention, long before the advent of white men, of the snow house. Some Eskimo devised the arch with his snow blocks which he built up in spiral courses. To this day the snow houses are the only comfortable type of house in which to live during an Arctic winter. They are constructed in various sizes, from the little igloo of the hunter, in which he spends one or two nights, up to the great community house, sometimes twelve or fourteen feet high. The latter house usually is built on a smooth spot on the ice and most of the tribal dances and ceremonies are held in it. The younger men use it as sort of a gymnasium where they can wrestle and show their skill and strength in various ways. The medicine-men often carry on their mysterious rites in the ceremonial houses, and meat is cut up and divided here. In Eskimo land if only one hunter is successful, he always divides his kill with the rest of the band.

CHEWING SEALSKIN

The process of chewing softens the stiff skin, but often results in damage to the teeth, as described by the author

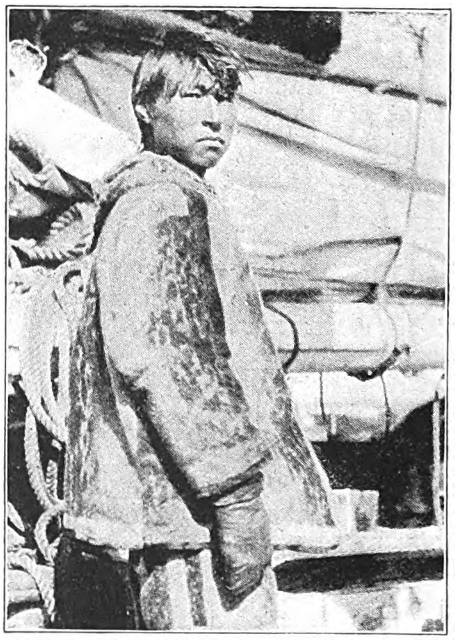
IN extremely cold days in winter, say 65 degrees or 70 degrees below zero, the children come into the big snow houses to play their games. One of these games, called seal hunting, is a great favorite among the boys. Two boys will take a sealskin with several round holes cut in it, and each will hold one end. Another boy will take a piece of skin cut out to represent a seal, and this he moves around underneath the holes of the big skin. Standing nearby is the boy who is supposed to be the hunter. He holds a small spear in his hand, and as the imitation seal passes under the holes he tries to spear it. A close record is kept of the number of times a boy hits the seal, as this is supposed to indicate whether or not he will be a successful hunter when he is a man.

Another game is played by both men and boys with a little ivory polar bear which has a number of holes drilled into it. This is attached to a piece of string with a sharp pointed bone tied to the end. The bear is tossed into the air, and the game is to catch it on the bone. If the bear is missed it strikes the player on the knuckles; this is supposed to represent a bite from the bear.

The little girls come to the big snow houses to play with their dolls, and their mothers to gossip, sew, and soften their husbands' boots and other clothing by chewing on them. It is not an uncommon sight to see an old woman with her teeth worn down to the gums from chewing upon seal and caribou skins.

SUMMER is the happy time for the Eskimos, for as soon as the sun is high they move out of their snow houses and into their summer houses or *tupiks*, which are made of sealskin. The rivers and the sea teem with Arctic trout, salmon, seals and walrus. The Eskimo always takes his share of ducks and geese as they fly north on the way to their nesting places on the tundra lakes. The polar bear is no longer a menace and is easy to kill in the water or on the small ice pans. He, too, has plenty to eat, and the fear of having a big polar bear crashing into an igloo looking for food is over for a time.

The Eskimos have two kinds of native boats. One is a large boat in which all the family can ride, as well as numerous dogs. This is called an *umiak* or "woman's boat," and is made of sealskins sewn together and lashed



SUMMER CLOTHES

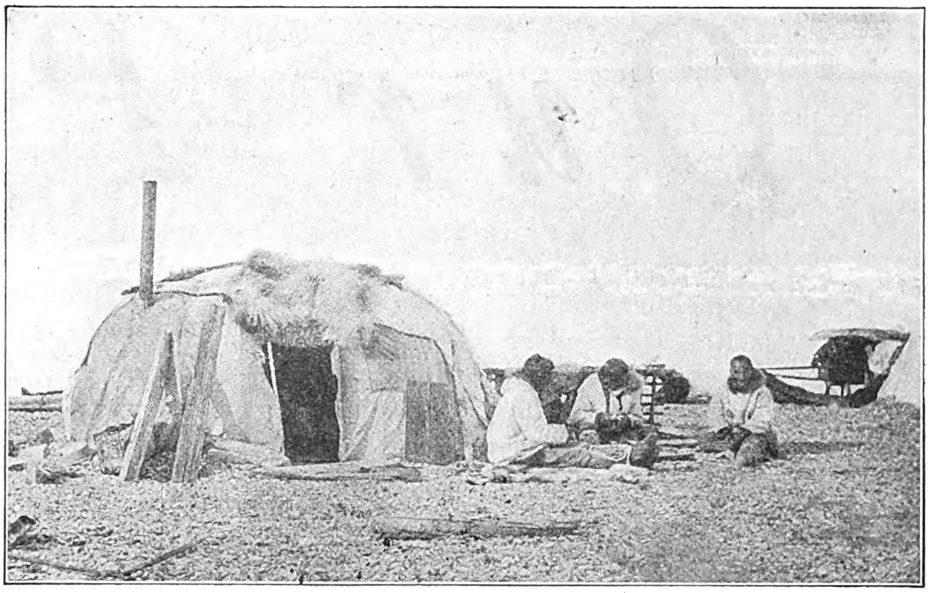
An Eskimo male dressed in the sealskin suit that is the standard summer costume around a framework of whale ribs and driftwood. It is a sea-worthy craft, and with a square sail made of intestines and with a fair wind it travels swiftly up and down the coasts.

THE man's boat is called a *kaiak*, and he uses it for hunting. This craft, usually only about three feet wide and ten to fifteen feet long, is probably the most sea-worthy and effective small boat in the world. Made of driftwood covered with seal skins, it has only a small hatch left in the top for a man to crawl into. He sits on the bottom of the boat and lashes his water jacket, made of some water-proof skin, to the gunwale of the hatch. The sleeves of his jacket are then tied about his wrists and the hood pulled tight under his chin. He is then practically shut in, so that although water may pass entirely over him, scarcely a drop enters the craft. He propels himself swiftly with a paddle, in most cases a double one. If the *kaiak* should happen to tip over, it is perfectly all right with the Eskimo, for with a flip of his paddle he rights it and travels merrily along. I have seen them spin their *kaiaks* in the water like a pinwheel.

Walrus hunting is probably the most dangerous occupation for the *kaiaker*, as it often happens that a wounded walrus will turn and attack the hunter. If he does this, a thrust from a lance sometimes will stop him, but if it does not, and he tears the thin skin of the boat with his sharp pointed tusks, the Eskimo is out of luck, because few Eskimos can swim even if they could cut themselves loose from the boat. As a rule two men travel together on a walrus hunt, and if one boat is attacked, the other man endeavors to rescue his companion. It is a difficult task, however, for if one walrus in a herd attacks, all the others seem to think it is the proper thing to do, and act accordingly. Then the hunters have to do some tall hustling to get away from that locality, if they want to live to hunt another day.

WOMAN AND BABY

Within the wide hood sleeps the baby. See also illustration at bottom of page 105



ESKIMO SUMMER CAMP

Although the traditional home of the Eskimo is the arched *igloo*, it is used only in winter. In summer, they move to their *tupiks*, which are summer homes covered with sealskin

Whale hunting is the true test of skill for the *kaiaker*, and when a number of Eskimos in their little hundred-pound boats put their harpoons, with floats attached, into a twenty-five ton whale, all kinds of things can happen, and most of them are unpleasant for the hunter. But the Eskimos have to live, and when they see a whale they go after him, and often tow him home to the beach for their waiting families and dogs.

The clothes worn by the Eskimo are the only practical garments to use in the cold Arctic winter, and they have been adopted by all successful explorers of the north. In general it is the most complete costume worn by American natives. Dressed skins of the caribou are preferred for clothing, but fur skins and pelts of birds sewed together are also used. In various regions the costumes present tribal differences in cut and ornamentation. In Alaska the costumes are quite similar, but the woman's coat is provided with a large hood and her leggings are made into one garment with the moccasins, while the men wear breeches and long boots. Two suits of clothing are always worn in winter, one with the hair next to the skin, and the other with the hair turned out.

AMONG the so called "blonde" or Copper Eskimos, who live west and north of Hudson's Bay, both men and women wear coats with long tails down the back. These look very much like the formal dress coat worn in civilization. Among these people the only way I could tell a man from a woman was by the size of the hood on the coat. A woman's hood is made large because children are carried naked against the mother's back until they are old enough to walk and take care of themselves.

In south Greenland, Eskimo women dress in dyed sealskin garments in summer; blue and red seem to be the favorite colors. Some of these costumes are elaborately and beautifully decorated with masses of beads.

IN north Greenland, blue and white fox skins are used for clothing. Often a suit of clothing from this region would have a market value of about 1000 dollars in civilization for the skins alone. The men of the region prefer to have their trousers made of polar bear skin, as it does not tear as easily as fox.

Living for centuries under extreme conditions, the Eskimos have survived untold hardship, increased in numbers and maintained a cheerful and friendly disposition through it all. Any normal white man who has been in contact with them respects and admires their many fine qualities. Naturally, their morals and manners are difficult for a person reared in the knowledge of a different code. Honesty is inculcated in the young and is exacted by all the Eskimos. A murderer is often put to death by the friends or relatives of the murdered person. Truth, honesty, and the safeguarding of human life could be the slogan of the Eskimo, for they are recognized as essential to the peace and prosperity of all. As a whole the Eskimos I have met, who are supposed to be uncivilized, can teach white men much respecting the happiness and well-being of others with whom they come in contact.

Our Point

Welcome Home

HENRY FORD has entered into a contract with the state of Para, Brazil, under the terms of which he has been granted a concession of 3,700,000 acres of land to be developed into a rubber plantation. The Ford Industrial Company of Brazil which was organized to exploit the concession and which has Edsel Ford as its president, contracts to plant rubber trees at a specified rate per year and obligates itself to pay a percentage of the profits after the first 12 years to the state of Para and the municipalities within the borders of the concession. In return, the company is to be exempt from taxes for 50 years, import duties on machinery and equipment, and is authorized to construct warehouses, docks, factories, schools, and whatever other buildings may be necessary, and is allowed to export its rubber without supervision.

For many reasons, the return of rubber to its original home has been joyously acclaimed by the western world. Perhaps the greatest reason is that, although 78 percent of the world total of 29,505,475 motor vehicles—using tremendous quantities of rubber—are in the United States, this country has been dependent for its rubber upon an outside monopoly. Now, with rubber being cultivated on an extensive scale in Para, from whence the original seeds that started the East Indian plantations were taken, some hope for relief may be seen. Results will not be immediate for it takes years for rubber trees to reach productive age and, of course, a plantation must be developed slowly, but it is possible that, in years to come, an amount of rubber at least sufficient to compete with that produced by foreign enterprises and to hold the price to a reasonably low level, may be produced by this American company for American users.

Dangerous Wastes

PROMPTED by the presence of waste crank-case oils in large quantities in the sewers of the District of Columbia, the Engineer Department of the District began in January, 1928, a survey of cities in this country, Canada, and several European countries respecting the disposition of such wastes at garages, filling stations, and automobile repair shops. It had been ascertained that such drainings into the sewers contain an amount of gasoline sufficient to vaporize and thus create a fire and explosion hazard upon coming in contact with hot wastes from laundries, hotels, et cetera.

The questionnaire to city engineer departments elicited the information that they all realize the seriousness of the question, that 70 percent of them prohibit the disposal of waste oils in the sewers and that 25 percent do not prohibit it; 5 percent made no definite answer to the question. The facts that 65 percent of these cities reported trouble from oil in sewers and 35 percent reported fires and explosions, indicate that the situation requires more thorough study than has yet been given it.

Cities in America that are today utilizing waste crank-case oils, report the following ways of using it: for burning city garbage, in the manufacture of paints, for oiling concrete forms, as fuel oil, for the extermination of mosquitoes in swamps, for oiling dirt roads, and, when re-refined, for lubricating automobile engines. With this great variety of uses for these dangerous wastes, every city in the country should take measures to control the dumping of oil, should, in fact, make good use of the oil commercially. As the problem is aggravated by the increase of cars, many opportunities for the establishment of a paying industry in saving used oils will be seen by energetic, far-sighted men. Such businesses are already in operation but the field has only been touched; let others start similar ones and rid their cities of a menace while earning profits.

Engineering Fundamentals

WE were pleased, indeed, with the pronouncement in the inaugural address of Stevens Institute's new president, Dr. Harvey N. Davis, that, hereafter, this honorable old institution will build foundations in general engineering principles instead of giving specialized courses. Following on the heels of, and a step over and above, the thought conveyed in our editorial in August, 1928, which urged a prolonged period of training in the fundamentals of engineering and a broader, general background before specialization, Dr. Davis' plan receives our unqualified approbation.

To show why Stevens Institute is adopting this tradition-shattering plan, Dr. Davis cited the case of a large technical school which offers 43 specialized courses. Obviously, he said, it is impossible to train a student to be 43 kinds of an engineer; and to give him an education in but one is highly undesirable. An attempt to do the first would make of his mind a machine-like hodge podge, while the latter course would so restrict his vision that he would be seriously handicapped. While the period of specialization is said to be in a moribund state, if the student wishes to concentrate his thoughts and energies in a single direction, he should not do so until he has "generalized" a great deal.

Engineering schools throughout the country will, no doubt, watch this far-sighted plan being worked out at Stevens Institute, and when it has proved successful—as we confidently expect it will—some of them will be jealous of Stevens for having planned and adopted it first.

Sea Safety

"SEAMEN without schooling in the fundamental code of conduct at sea and without a sense of discipline" is said, by some of the survivors of the *Vestris*, to be one primary reason for the great loss of life when that vessel foundered and sank in November, 1928. It is claimed that if the men had possessed a finer sense of loyalty to their duty—had not been of the class of "wooden men in iron ships"—a greater number of people would have been saved. This, however, is a psychological incidental.

The main issue is: "Why did the ship meet disaster?" Following this, comes the question: "Why was the life-saving equipment not sufficiently fool-proof to enable the passengers to save themselves regardless of the efforts of the crew?" As to why the ship sank, perhaps no reasonably definite answer will ever be obtained, but to the second question, the answer is simple: there is an urgent need for new and more efficient life-saving equipment.

The problem of reducing the hazards of the sea, recently given much prominence in connection with the loss of the *Vestris*, will now be studied more intensely than it has been since the sinking of the *Titanic*. Already,

# of View

awards are being offered for better life-saving apparatus (see page 121) and, during the coming spring, an International Conference On Safety Of Life At Sea will be held in London. At this, the first sea-safety conference since the incomplete one in 1913-1914, it is expected that the question, in all its complex ramifications, will by studied thoroughly. Revision of sea codes pertaining to the conduct of officers and crew, to the adoption of new apparatus, to ship inspections, et cetera, may be the result of this conference.

It is almost an assured fact that shipping may expect greater sea safety as the outcome of the cerebrations of the many minds now occupied with it. However, those whose duty, business, or pleasure carries them in ships, either continually or periodically, will look forward to the development of apparatus that will save them, whether or not life-boat drills have been perfunctory, inspections lax, and officers and crew negligent.

Political Water-Power

At last a modern Socrates has spoken for the people. Thomas A. Edison has, in effect, challenged those politicians who have been misleading the public with fatuous arguments about the supreme importance of water-power and its control by the government, to "define their words." But he has done more than that; he has himself defined their words and dispelled a harmful illusion. According to Mr. Edison, water-power can never take the place of fuel for the generation of electricity.

Numerous stock arguments such as: "water runs down hill and costs nothing while fuel must be mined, transported, and burned; the waterfall is a manifestation of great energy without apparent effort; water-power is America's greatest natural resource and can never fall into the hands of the 'interests' if the people are only intelligent enough to prevent them from doing so!" were deprecated by Mr. Edison. Of the factors entering into the question, he cited the following: the tremendous first cost of a hydro-electric station which must be wholly completed before its power can be sold in a distant market, this cost including the price paid for land for the plant and dam, investment in material and equipment, and the cost of construction of the dam, plant, and many miles of transmission line.

Contrasted to this, a steam plant has a low first cost because it can be built a unit at a time as the market demands and requires no dam and usually almost no transmission lines. Operation of a hydro-electric plant depends upon seasonal flow of water and requires, for economy, a close tie-in with fuel-burning plants. About 72 percent of the country's water-power resources are in a territory embracing only 21 percent of our power-requiring industries, most water-power being in inaccessible mountainous regions. Furthermore, whereas in the early days of water-power development, fuel-burning plants used three or more pounds of coal for every kilowatt-hour of electricity generated, the best plants today use less than one pound. Also, steam turbines are more efficient.

Save Your Life

The United States is rapidly becoming a despotism, the despot being the speed demon which invests the minds of all of us on occasion. Yet this desire for speed is more than a state of mind: it is an incubus which harasses, usurps the seat of logic, and drives us on with plausible arguments interlarded with such words as expedition, efficiency, et cetera, ad infinitum. A great many of us realize the fallaciousness of these arguments and yet ignore them because, perhaps, we have some doubt regarding our own reasoning; we feel that we *may* be left behind.

Proof to show us positively that speed is often a saver of so little time as to be absolutely unnecessary, is offered by the American Road Builders' Association. This association cites a test made by a Chicago taxi-cab company to show the futility of unreasonable speed as a means of gaining time. "Two cabs were started simultaneously, destined for a point nine miles distant, over a main thoroughfare of that city. One traveled at top speed and the other at a reasonable speed. The speeding cab arrived at its destination only four minutes prior to the arrival of the safety cab. Dozens of hazards were created (by the faster cab), lives were endangered, property imperilled, and laws violated—all for four minutes time."—!!! We have quoted the association; the exclamation marks are our own.

Only one thing further need be said: if you value a saving of one half a minute per mile more than you value the 30, 40, or 50 years you expect to live, then by all means, speed! Automobile hearses are much faster than the old horse-drawn ones.

To the "Calamity Ann" who continually cries that our coal will soon be exhausted, Mr. Edison points out that, despite the enormous amount of coal we have already used, only 1 percent of the available supply has been mined. Coal, therefore, "will carry us on indefinitely into the future and then, as now, water-power will be quite inadequate to meet the demands for electrical power."

At this point, the obvious quotation to make, were it not so trite and threadbare with use, is that which relates to "fooling all the people all the time." Mr. Edison's remarks, however, stand on his great fame and reputation: comment is unnecessary. Those "intelligent" people mentioned above may draw their own conclusions.

Dispelling the Gloom

Too many people committed suicide by jumping into the Thames from Blackfriars Bridge. London authorities became alarmed. What was to be done? After careful consideration, a practical application of psychological laws was decided upon as being the remedy or, rather, the preventative. The somber black, the sad and death-like hue of the old bridge, was done away with and in its stead, there burst forth upon the astonished gaze of the throng, a bridge that was a thing of living, breathing color; it had been painted light green trimmed with bright yellow. What the result of this psychological experiment may be there is no way of predicting. Possibly it will serve its purpose: the "happy" combination of colors may turn many a gloomy person away with a smile. But that smile may be one of amusement, and then again it may not be. Some attic artist, despairing of success for his canvases in the lying style so earnestly praised by Oscar Wilde, may come to die, rub his eyes, look upon this as a modernistic daub and the supreme affront to his art, and go away with a grim smile that promises revenge.

What Things Are Made Of—I

The New Physical Concept of the Universe. It is a Composite of Three Things—Protons, Electrons, and "Photons"

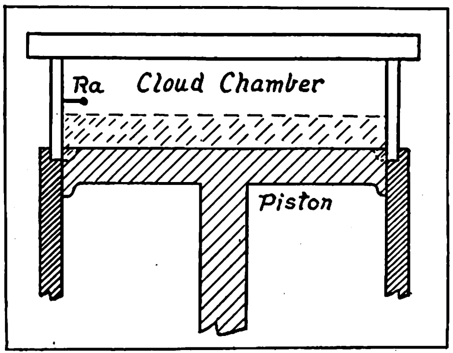
By ARTHUR H. COMPTON, Ph.D.

Professor of Physics, University of Chicago.
Member American Philosophical Society; National Academy of Sciences;
National Research Council. Nobel Physics Prize Winner, 1927

WHO is there who has not asked himself, "What is this world around me?" Rocks, trees, people—what are the parts of which they are made, and how are these parts put together? Light, radio waves, X rays—what are these radiations?

Upon such questions men have pondered since the beginning of thought. Until recently, opinions on these matters were speculative; but during the last heroic generation many of these questions have been answered with a definiteness which was unthinkable in an earlier era. It will not be possible in this brief survey to present adequately the great mass of evidence which has been collected regarding the nature of things. We shall rather discuss only a few typical experiments that tell us something about how things are made.

When we take apart this infinitely complex mechanism which we call dirt, or perhaps a diamond, or it may be a flower, we find it made up of a myriad of tiny molecules. Each of these molecules is itself complex but is more perfectly formed than the wheels of a watch, and has continued to run for billions of years without winding and without wear. We find that the molecules which make up matter in all its endless variety of forms are themselves built up of a few hundred kinds of atoms. Some of these atoms differ from each other by their chemical properties, others only in one respect, by their weights.



CLOUD MAKER

Figure 2: When piston is pulled down, the air in the chamber expands and cools

But we cannot stop here. Our few hundred atoms are themselves made of yet more tiny particles. It is as sung by the poet Pope:

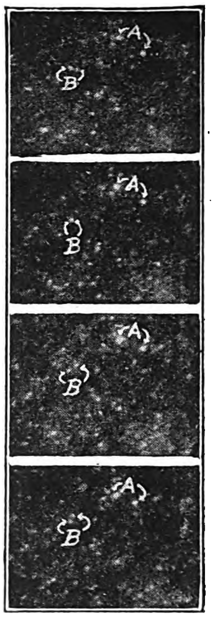
> "The larger fleas have smaller fleas
> Upon their backs to bite 'em.
> These smaller fleas have other fleas,
> And so ad infinitum."

These tiny particles show themselves through their electric charges. There are found to be two kinds of them, carrying positive and negative electric charges, respectively. But as nearly as we can tell, all those of any one kind are exactly alike. The positively charged particles, called *protons*, have most of the weight of the atom, while the negatively charged particles, or *electrons*, are the lively little bodies responsible for chemical combinations, electrical conductivity, and the like. By grouping themselves in various ways these little particles form the various atoms.

ROCKS and trees and people do not, however, make up the whole of the universe. How about the sunlight that makes the trees grow and gives us warmth? Newton wrote of light as consisting of little particles or corpuscles. Huyghens and Fresnel explained its properties in terms of waves, and Maxwell, by introducing the idea that these waves are electromagnetic, foreshadowed the recent developments in X rays and radio. But recently Einstein has brought back a modified conception of Newton's light corpuscles, now called *photons*, and evidence for their existence has become convincing.

At the present moment, light is the darkest of the physicist's problems. It seems that we can prove that it consists of waves; but we can also show that it consists of little particles. The two conclusions cannot really be inconsistent; but how light can consist of waves and at the same time of tiny particles is as yet an unsolved riddle.

Just a century ago a botanist named Brown was examining some tiny objects suspended in water under a high power microscope. "They're alive," he exclaimed. But to make sure, he turned his glass on some wax particles suspended in the same way, and found that they also moved. Everything that is small enough moves, he found, unless it is held fast to something solid. These are the "Brownian movements." It is as if a swarm of little "Brownies" were pushing the globules hither and thither. In Figure 1 is shown a series of moving pictures of these motions, taken with the ultramicroscope. Notice the motion of the particles *A* and *B*. The smaller particles move faster than the larger ones. Under the microscope the Brownian motion has the appearance of a jazz dance on a crowded floor.



MOLECULAR JAZZ

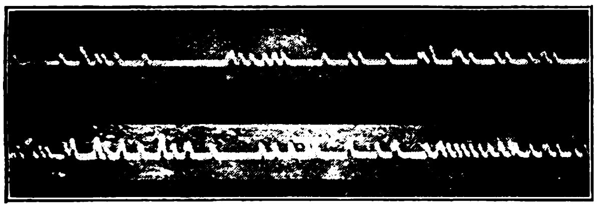
Figure 1: Four successive "movie" pictures of oil particles suspended in water, magnified 2700 diameters

WHAT is the cause of this motion? For many years physicists had explained the pressure of a gas on the walls of a vessel which holds it by supposing that the gas is made of little particles, the "molecules," which dart about in the gas at high speed. They could calculate how fast these molecules must go to account for the observed pressure, and found that if the energy of their motion was proportional to the temperature, they could account accurately for the increase of pressure with temperature. The calculation showed too that the energy of motion of the little molecules should be the same as that of the big molecules, which would mean that the little ones must move faster.

Now a careful study of these Brownian movements, such as those shown in Figure 1, reveals the fact that the energy of motion of these particles under the microscope is just what the kinetic theory says a molecule should have. And the speed of their motion increases at higher temperatures, just as the molecular theory predicted. At one instant more molecules strike a globule on one side, and the next instant more strike on another. In fact, in a very real sense, one may correctly consider the motion of these little particles as true molecular motions. We must remember, however, that these globule "molecules" consist of perhaps a million atoms each.

Such things as this show us that our idea of "dead matter" is indeed far from the truth. We have a glimpse of the continual activity in things we call dead.

Not long ago a group of us were camping beside a frozen lake in the Himalaya Mountains, 13,000 feet above the sea. The lake was surrounded on three sides by mountains. At about the middle of the day, when the wind was blowing over the mountains, one could see clouds gathered about their peaks, clouds which evaporated almost as soon as they were formed. On one side of the mountains the clouds could be seen rising with the air, and becoming more dense as the air expanded at the higher levels. On the other side, where the air was coming down, the clouds, being compressed at the lower levels, gradually evaporated into thin air. The air was so cooled by expansion when it was rising that the moisture condensed into clouds, which would then evaporate as soon as the air sank to a lower level and became warmed by compression.



COUNTING ALPHA PARTICLES

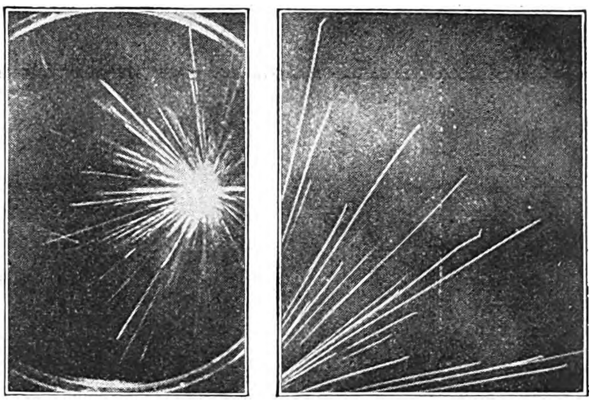
Figure 4: A record of the alpha particles entering a counting chamber connected to an electroscope (Rutherford)

Dr. C. T. R. Wilson tells me that it was while watching a phenomenon of this kind in his native hills of Scotland, that he conceived the idea of making artificial clouds by allowing moist air to expand. This study quickly revealed the fact that it is very difficult to make a cloud form unless there is something in the air, such as dust particles, which may act as nuclei for condensation. Even at a high mountain peak, the fact that a cloud forms indicates that there are some dust particles, although perhaps excessively minute, floating in the clear blue air.

It is possible, however, to remove the dust from air. The air may be filtered through cotton, or if the water droplets in the cloud are allowed to fall as rain they carry the dust particles down with them. When the air has thus been cleaned, Wilson found that the cloud would condense on ions if any were present. Ions are the electrically charged pieces of broken atoms or molecules. The "alpha rays" from radium were known to produce ions in the air through which they pass. So Wilson tried the experiment of making clouds condense on the ions produced by alpha rays.

The apparatus which he used in this experiment is shown diagrammatically in Figure 2. There is a chamber with glass top and sides, which is closed at the lower end by a movable piston. This chamber is filled with air, saturated with moisture. The piston is suddenly moved downward to give the proper degree of expansion, but no cloud forms, because the air has been carefully freed from dust. Then alpha rays are allowed to shoot from a speck of radium placed in the chamber, and a cloud forms on the ions produced.

Two photographs which Wilson took of the clouds thus formed are shown in Figure 3. Instead of a diffuse cloud surrounding the radium, we see a group of sharply defined lines radiating from the source. We see that the alpha rays do not spread uniformly in all directions but are concentrated along definite, straight lines. The interpretation is clear. These rays are little particles which shoot through the air at such high speed that they break in pieces the molecules through which they pass, leaving ions to mark their trails. The ions are in turn made visible when droplets of moisture condense upon them. Each of these linear clouds thus marks the path along which traveled one of the particles ejected from the speck of radium. For want of a better name we shall call the thing which is responsible for such a track an "alpha" particle.



MORE ARTIFICIAL CLOUDS

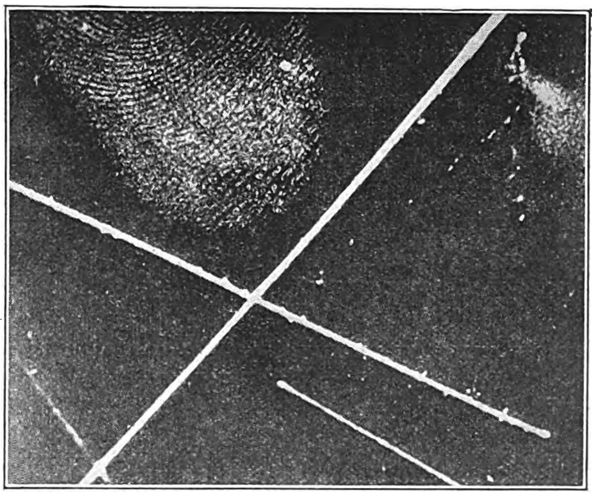
Figure 3: Two photographs of the cloud formed in air ionized by alpha rays shot out from radium (Wilson)

But what are these alpha particles? The question has been answered in a striking manner by Rutherford. He surrounded a strong radium preparation by a glass vessel with walls so thin that the alpha particles could pass through. After a long period of time he found that a gas was accumulating where the alpha particles were collecting. This gas was compressed into a small tube and its spectrum examined. Its spectrum was found to be exactly like that of helium gas. In other words, these alpha particles were found, when collected in large numbers, to constitute helium. We may call them, then, *atoms* of helium.

Using this method of collecting alpha particles or helium atoms it is possible to estimate in a very direct manner the number of atoms in a given volume of gas. We can count directly the number of alpha particles ejected from a weak preparation of radium. This might be done by counting the trails of the alpha particles in photographs of the type shown in Figure 3.

A better method, however, is to count them electrically, using a sensitive electroscope which records each alpha particle as it enters a small chamber. Figure 4 shows a record which Rutherford obtained in this manner of the alpha particles escaping from a weak source of radium. Of course the number of alpha particles is proportional to the amount of radium, so by comparing the strength of the radium preparations the number of alpha particles in the gas collected in the spectrum tube can be estimated.

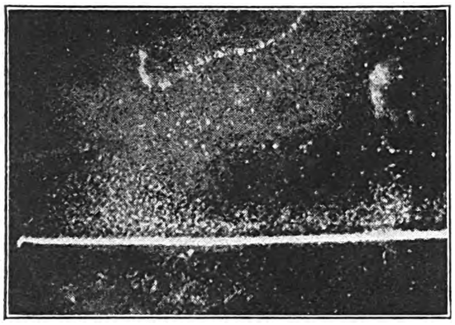
The number thus determined is a perfectly tremendous one. It means little to say that in a thimble full of helium there are atoms to the number of 3 with 19 ciphers after it. Let us suppose that we could paint each of the molecules in a thimble full of water



From Eddington, "Stars and Atoms". Courtesy of Yale University Press

TWO CLUES

Figure 5: Would you deny the existence of the maker of the finger print because the print was all you could see?



THREE TRAILS

Figure 6: Trails of an alpha particle (helium atom) and two beta particles (that is, electrons) shot out from radium

green. Let us now spill this water on the ground and wait for thousands of years until it has flowed to the sea, has re-evaporated and rained over the earth so that our water molecules are distributed all over the world. Then wherever we should go each drop of water that we should examine would probably have in it one of the green molecules from the original thimble.

But perhaps you will say, "Show us the atom and we will be satisfied." Let me ask you, then, what is the spot in the corner of Figure 5? If you answer, "It is a man's finger," I shall reply, "Then the heavy white lines across the paper are helium atoms."

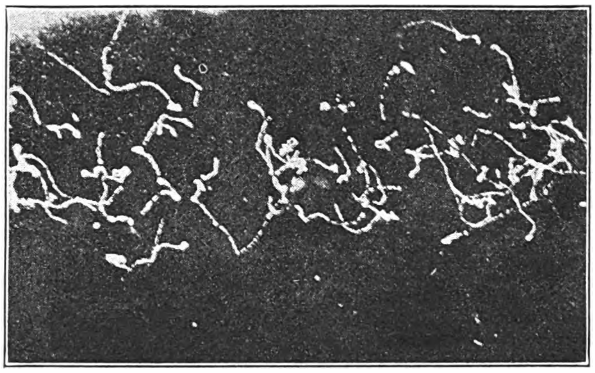
BUT if you are more cautious and tell me that the spot is the print of a man's finger I shall be equally careful and state that the white line is merely the print left by the helium atom.

The story is told that toward the close of the 19th Century one of Lord Kelvin's students approached him with the question, "What do you think of this new theory that the atom has structure?" "What!" said Kelvin, "the atom has a structure? The very word 'atom' means the thing that can't be divided. How then can it have a structure?" The insubordinate youth is said to have replied, "That shows the disadvantage of knowing Greek."

In Figure 6 is shown the trail of an alpha particle, and above it two fainter trails, one crooked and the other straight. From their appearance one would guess that these fainter trails are due to objects much smaller than the alpha particle. But the alpha particle itself, as we have seen, is an atom of helium, which is next to the smallest atom that we know. What then can these other particles be? Let us call them "beta particles" to avoid any suggestion as to their nature. In Figure 7 are shown such beta particles knocked out of air by the action of X rays. It is found that they can be ejected from anything. They are, that is, a common component of all different forms of matter of whatever nature.

The photograph shown in Figure 8 was taken with a strong magnetic field applied to the expansion chamber when a cloud was formed. It will be seen that the trails of the beta particles are curved in circles. Such a bending of paths is just what we should expect if the moving particles were electrically charged. For a magnetic field produces a force on a moving electric charge just as it does on a wire carrying an electric current. From the direction of the curvature one can show that the charge carried by the particle is negative. If we can measure the magnitude of this charge it will be possible to tell from the curvature of the trails what is the mass of the beta particles.

No one has been able to devise an electroscope sensitive enough to measure the very minute charge carried by one of these beta particles. But Millikan has measured their charge in a most interesting manner. He caught a tiny droplet of mercury between the electrified plates of a condenser and threw a beam of ultra-violet light on the droplet. The effect was to eject a beta ray from the droplet. The droplet was left with a positive charge equal to the negative charge carried away by the beta particle, and the electric field of the condenser could be so adjusted that the force on the droplet's charge would just balance its weight. Knowing the weight of the droplet, it was thus possible to determine its charge. It was found that each beta ray which left the droplet carried with it the same negative charge, a charge equal in magnitude to that carried by a hydrogen ion in electrolysis.



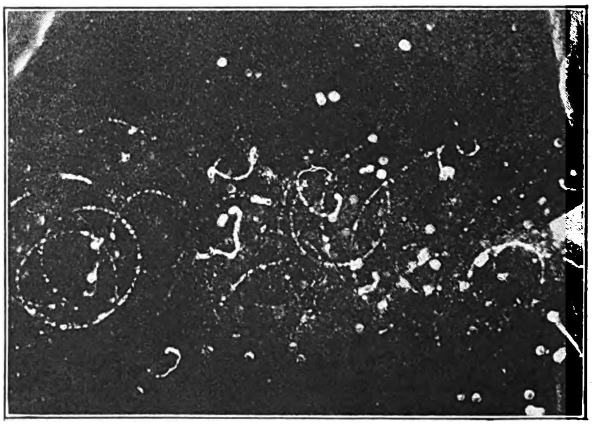
RESULT OF COLLISIONS

Figure 7: Beta particles (electrons) produced by X rays passing through air and knocking them out of atoms

Having thus found that the charge carried by a beta particle is the same as that carried by a hydrogen ion, magnetic deflection experiments such as those shown in Figure 8 indicate that the mass of the beta particle is only 1/1845 that of a hydrogen atom. We were thus right in our guess that these beta particles are things much smaller than the smallest known atom. Since we find that such particles can be removed from every kind of matter, it follows that they must be one of the components of which atoms themselves are built. We shall now give to these beta particles the name of *electrons.*

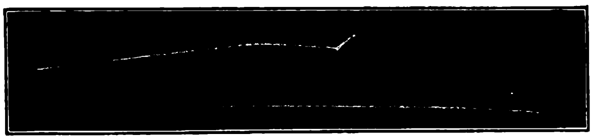
IT is not possible to suppose that atoms are constituted solely of electrons, for electrons have negative charges, and atoms are electrically neutral. The atoms must, therefore, have some positive charge as an essential part of their structure. An examination of the trails of alpha particles such as those shown in Figures 9 and 10 give an important clue to the distribution of the positive charge within the atom. Let me call attention to the pair of tracks in Figure 9, one of which goes nearly straight and the other of which has two rather sharp breaks. It is really a most remarkable thing that this one track is so straight, since a simple calculation shows that in the portion of the track shown in this figure the alpha particle has passed through some 20,000 atoms. But we have seen that the alpha particle itself is nothing but a helium atom with a double positive charge. This photograph therefore means that while the helium atom is passing through the oxygen or nitrogen atoms of air, we have repeated 10,000 times the most unusual phenomenon of two bodies occupying the same space at the same time.

Occasionally, however, the alpha particle strikes something so hard and immovable that it must change its course. From the fact that there is only about one such collision for every 10,000 atoms traversed, it is clear that the object struck is much



CURVED PATHS

Figure 8: A magnetic field attracts a moving electric charge, whether it moves in a wire or in free space



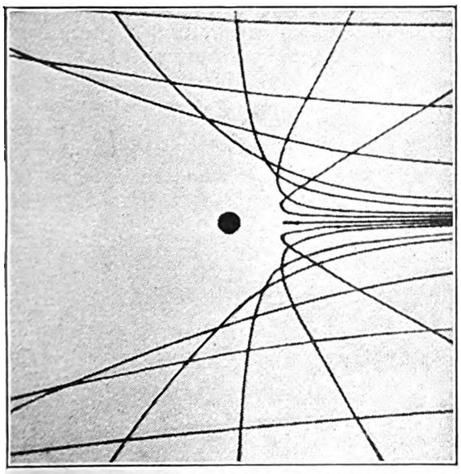
A PARADOX?

Figure 9: The "paradox" is stated in the text. The answer is: the atoms consist mainly of emptiness

smaller than the atom itself. Further, the manner in which the impinging helium atom glances off shows that the object is heavier than an atom of helium. It is not, however, a collision with a stone wall. You see in Figure 9 that the particle struck by the alpha ray itself rebounded and left a little track.

Figure 10 shows a similar event more clearly. From the relative length of these two tracks it seems probable that the object struck has a mass several times that of the helium atom, or about that of the oxygen atom. Collisions of this character indicate that there must be something within the atom hard and impermeable, very much smaller in size than the atom itself, yet possessing practically the whole mass and weight of the atom. This something, whatever it may be, has been named the atomic *nucleus.*

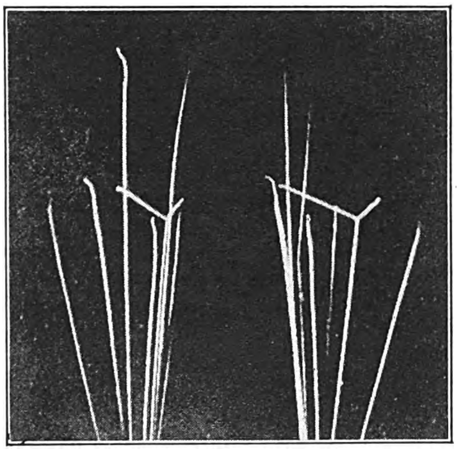
It has been shown by Rutherford that the atomic nucleus deflects an alpha particle as if the force between them were one of repulsion between two electric charges. On this view the paths of alpha particles passing a nucleus should be as shown diagrammatically in Figure 11. All of the particles are bent slightly, but only those coming close to the nucleus are bent through a large angle. It is obvious that if the charge on the nucleus is large its effect will extend to a greater distance. That is, the nucleus will act as a larger obstacle and the number of collisions will be greater. So by counting the number of collisions occurring when a group of alpha particles passes through a known number of atoms we can determine the charge on the nucleus. Measurements of this kind have shown that the nucleus of the hydrogen atom has a positive charge equal to that of one electron, helium that of two, lithium three, and so on down the list of chemical elements to uranium with a charge equal to 92 electrons on its nucleus.



THEORETICAL PATHS

Figure 11: Reflections of charged particles shot toward a charge of the same sign

This discovery suggests that the nucleus of the atom may be built up of units carrying a positive charge equal to the negative charge of the electron. Such a unit we find in the nucleus of the hydrogen atom. It is perhaps surprising that the positive unit of electric charge should be associated with a mass almost 2,000 times as great as that associated with the negative unit.



TWO CARROMS

Figure 10: Double photograph of a collision of alpha particle with oxygen atom

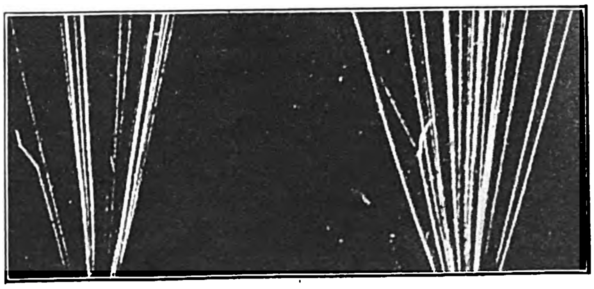
Rutherford has, however, performed a series of experiments which gives good reason to believe that our guess is correct. These experiments consist in shooting alpha rays from radium through various substances. It is found that particles having the same charge and mass as the hydrogen nucleus can be knocked out of some of the lighter elements. An event of this kind is shown in Figure 12, a remarkable photograph taken by Mr. Blackett. We see here the impact of an alpha particle with the nucleus of a nitrogen atom. There is a thin trail left by the hydrogen nucleus escaping from the nitrogen nucleus.

Similar results are obtained when alpha particles traverse boron, aluminum, phosphorus and certain other light elements. It would seem that the only reason that hydrogen cannot be liberated from other elements by such methods is that our hammer, the alpha particle, does not strike a sufficiently powerful blow.

The evidence thus seems very strong that the nuclei of the various atoms are indeed built up of an aggregate of hydrogen nuclei, which we shall now call *protons,* cemented together with electrons. In the case of oxygen, for example, the nucleus presumably consists of 16 protons, corresponding to the fact that the oxygen atom weighs 16 times as much as hydrogen. To hold these protons together, there will be eight electrons, leaving a resultant positive charge on the nucleus of eight units.

It is this nuclear charge of eight electronic units which is detected by the alpha particle deflections, such as those in Figure 10. Around this nucleus, arranged as a sort of atmosphere, will be distributed eight more electrons, making a neutral atom. These outer eight electrons are responsible for the ordinary physical and chemical properties of oxygen.

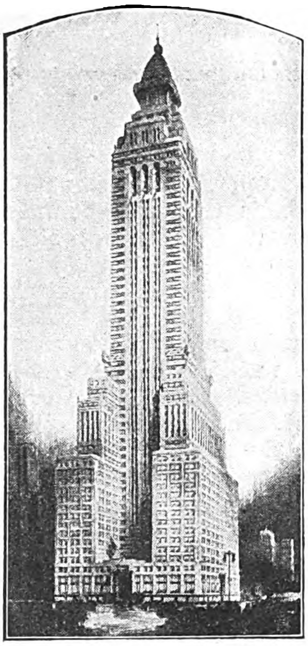
¶ In the second part of his fascinating article, to appear next month, Dr. Compton will conduct the reader through a lucid discussion of some of the newer aspects of physics, to which the discussion in the present article is more or less introductory: whether, for example, light consists of waves in some medium conveniently labelled "the ether," or whether it is something corpuscular, as Newton believed; the Einstein interpretation of the theory of the emission of photo-electrons, which carried us far but not far enough; the peculiar alteration in wavelength of reflected X rays, and finally the paradox of electron-waves, involving the new wave mechanics which have not attracted so much attention. He will explain and interpret the recent revealing experiments of Professor G. P. Thomson of the University of Aberdeen, which have already gone far to demonstrate the accuracy of the new wave-electron concept. Altogether, the discussion is a most notable one.—The Editor.



MODERN ALCHEMY

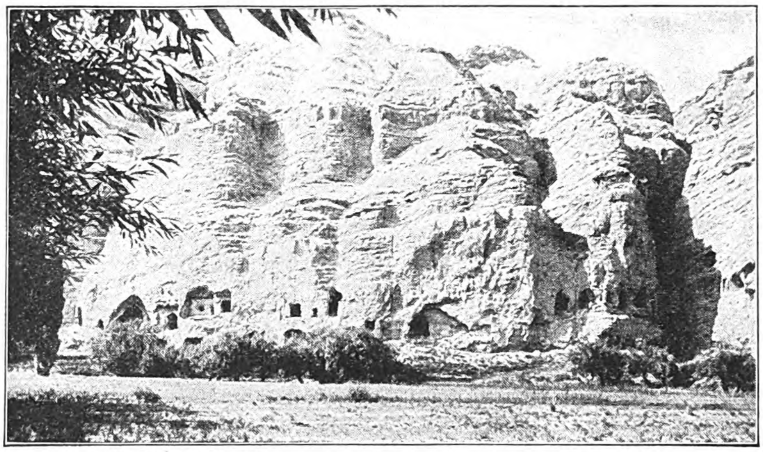
Figure 12: A double photograph of an alpha particle knocking a hydrogen nucleus (proton) out of a nitrogen atom (Blackett photo)

From the Scrap-book of Science



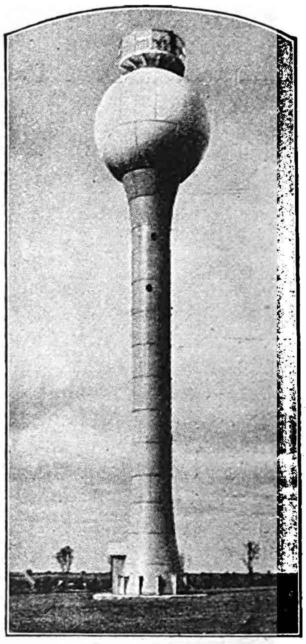
808 FEET HIGH

When the Chrysler building, in New York City, is completed in 1930, it will be one of the three or four tallest buildings in the world. Its cost will be about 14,000,000 dollars, and in many ways it will surpass any other building



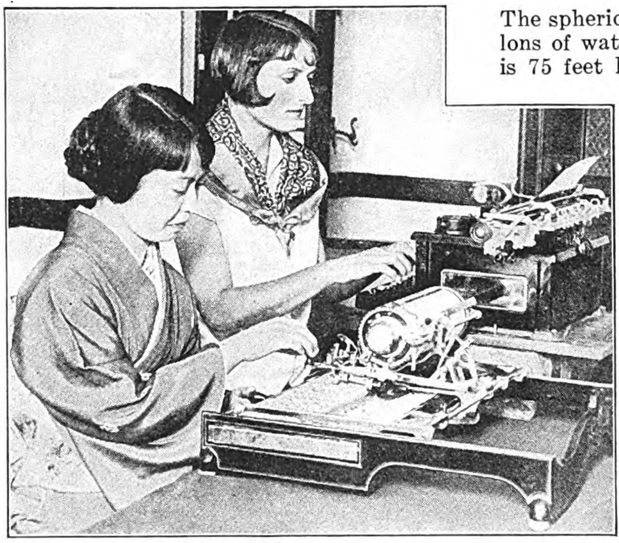
PRESENT-DAY "PRIMITIVE" DWELLINGS

Hundreds of semi-savage tribesmen of eastern Turkestan reside in "apartment dwellings" such as this, cut into solid rock. Each "apartment" is separate, has its own entrance door, and in most cases consists of but a single room, very simply furnished



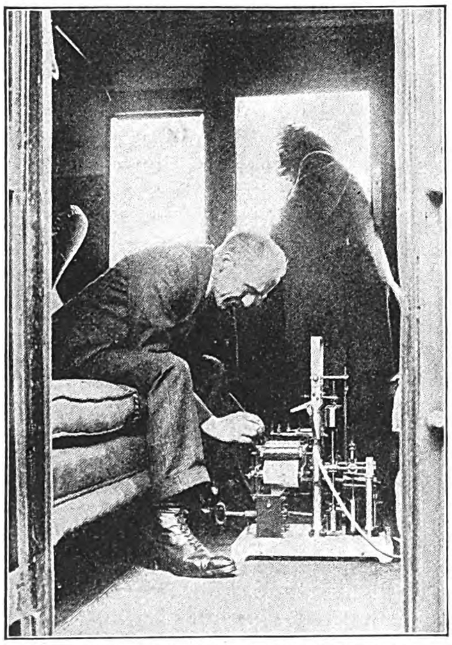
TANK-LOOKOUT

This combined water tank and lookout tower is at Wentz Camp, a Boy Scout camp near Ponca City, Oklahoma. The spherical portion holds 30,000 gallons of water. The cylindrical portion is 75 feet high and encloses a stairway



IT WRITES JAPANESE

Due to the great number of characters in written Japanese—about 100,000—it has been difficult to construct a typewriter for the language. The one shown here, being operated by Miss Kotoji Sato, was invented 14 years ago but only recently made practical by the condensation of the characters to 3000. It is being used extensively by many Japanese who are engaged in business in United States

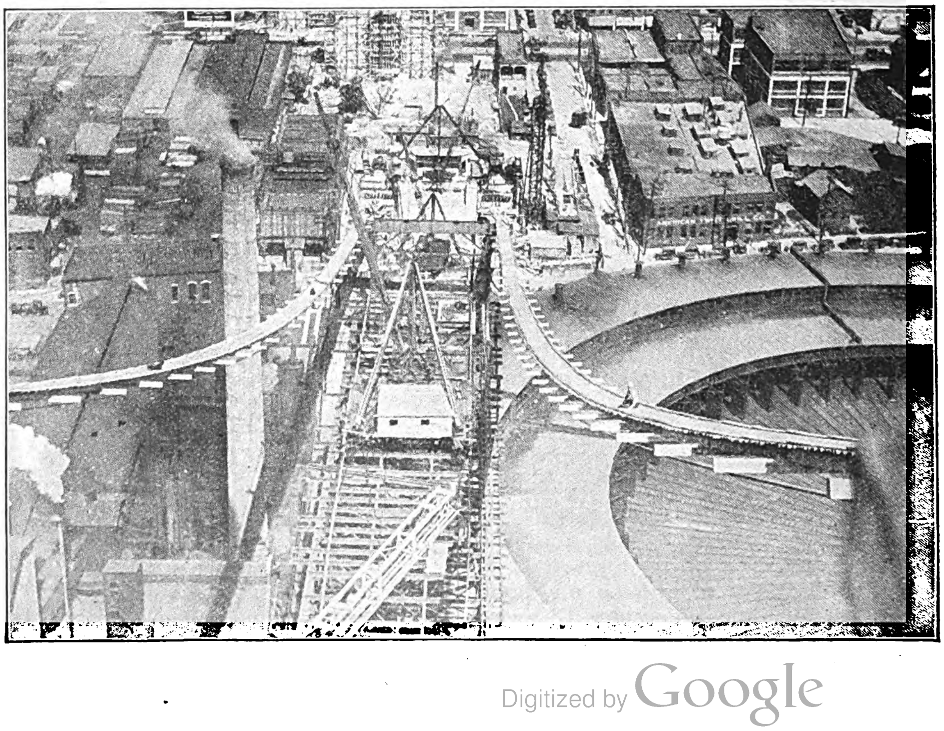


MEASURING RAILROAD JOLTS

In order to determine any defects in the balance of railway cars, the London and Northeastern Railways uses this Hallade track register. Clockwork controls a roll of white paper on which three pointers record oscillations due to car unbalance or track variations

INTERNATIONAL BRIDGE ➤

The city of Detroit was connected with Canada recently when two pairs of one and seven eighths inch steel cables were installed between the towers of the new bridge that is rapidly nearing completion across the Detroit River. This view was taken from a tower and shows the catwalks.



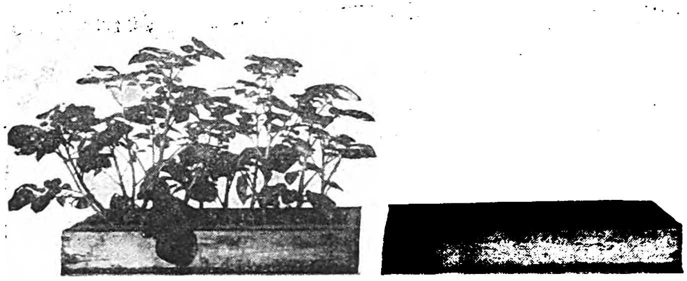


FIGURE 1.
Left: Potato plant treated with solution of sodium thiocyanate, and *right:* Identical seed samples soaked for the same period in water

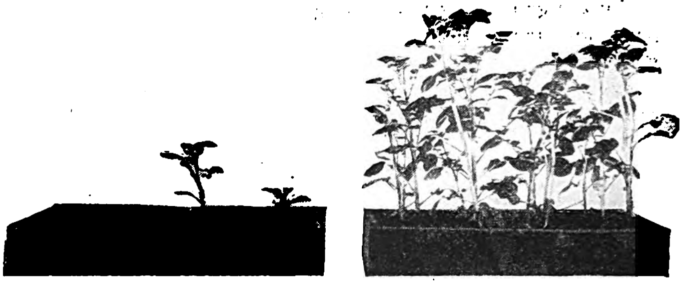


FIGURE 2.
Left: Normal growth of tubers of the "Irish Cobbler" variety, compared with samples (*right*) treated with ethylene chlorohydrin

Chemical Alarm Clocks Arouse Sleepy Plants

Tubers, Shrubs, and Flowers Begin Their Natural Activity Ahead of Nature's Schedule in Response to Chemical Accelerators

By A. E. BUCHANAN, JR.
Corresponding Editor, SCIENTIFIC AMERICAN

"BEAUTIFUL SPRING" has long been credited with a mysterious vital force which annually awakens dormant plants, inspires the sap to flow with fresh vigor, and clothes the drab winter world in a new dress of tender green. Leaving this phase of seasonal change to the poets, science has turned its searching scrutiny on "the flowers that bloom in the spring, tra la" to seek the *modus operandi* of spring's miracle and has found that certain chemical substances possess the remarkable property of awakening dormant plants and stimulating very appreciably their early development.

So effectively does the chemical alarm clock cut short the rest period prescribed by Nature that lilacs can be made to bloom at Christmas time, and potatoes, exposed to vapors of ethylene chlorohydrin, gain from two weeks to two months growth on the untreated tubers planted at the same time. The discovery is an eye-opener for potatoes, of course, but none the less for horticulturists and scientists, who see great possibilities in its commercial development, as in forcing the early blooming of certain potted plants which are favorites in the florist's trade.

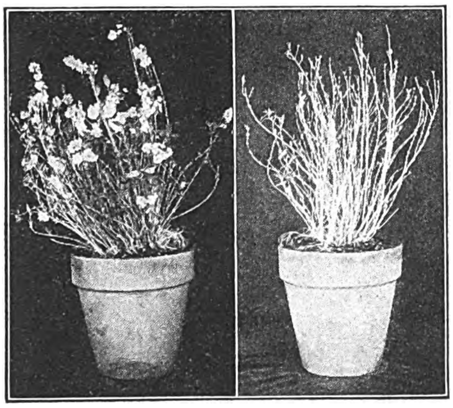


FIGURE 3.
Left: Deutzia treated with vapors of chemicals. *Right:* Check plant, untreated

CHEMISTRY has played an important rôle in the production of artificial fertilizers which supply plant food in readily assimilable form. This new application of chemicals to the initiation of growth, however, has no direct relationship to fertilizers, for the substances employed are apparently not utilized directly as food and produce results seemingly out of proportion to the energy they could furnish even if they were absorbed and oxidized. The how and why of this synthetic springtime is thus far limited to the general hypothesis that the chemical treatment induces some internal physiological condition which leads to the renewal of growth.

As far back as 1896, botanists have known that chemical treatment of certain dormant plants induces growth, but it is only recently that the phenomenon has been elevated, by intensive research, from the status of a scientific curiosity to that of a commercially practical process. Lemons, for example, are now quite generally subjected to ethylene gas to hasten the development of the desired yellow color.

Although the fruit is commercially mature when harvested, it may have considerable amounts of green color in the rind which is gradually replaced by yellow, if stored under favorable conditions. Concentrations of ethylene as low as one part to 1,000,000 parts of air hasten the coloration, although one part in 5000 is generally used commercially, in order to make up for loss of the gas by diffusion. While the mechanism of this phenomenon is not understood, it has been found that the presence of ethylene stimulates the life processes of the fruit, the rate of production of carbon dioxide from the respiration of the fruit being doubled and even tripled in 48 hours by exposure to air containing ethylene.

The latest and most spectacular results in this unique field have been achieved by Dr. F. E. Denny, botanist of the Boyce Thompson Institute for Plant Research, Inc., of Yonkers, New York. Approaching the study with the thoroughness and care of the true research worker and armed with a broad background in botany and chemistry, he has accomplished wonders in the artificial stimulation of growth, some of which are illustrated here.

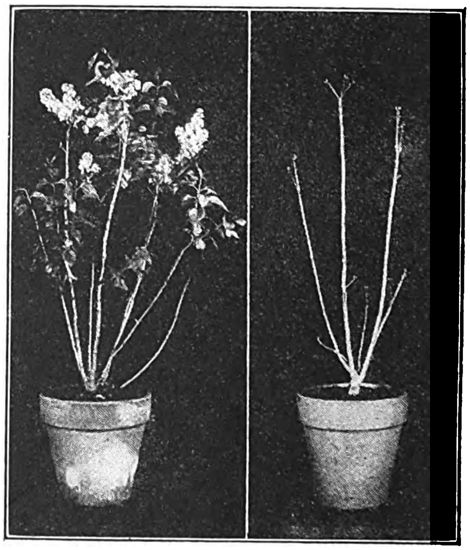


FIGURE 4.
Left: Lilac grown with aid of accelerators
Right: Normal growth without treatment

Potato growers know that good seed potatoes are those which have been stored for several months. Freshly harvested tubers germinate slowly and produce inferior stands, even if climatic conditions are favorable, because such tubers are in the "rest period." After experimenting with 250 different chemicals, two substances were found which effectively curtail this period of dormancy—sodium thiocyanate and ethylene chlorohydrin.

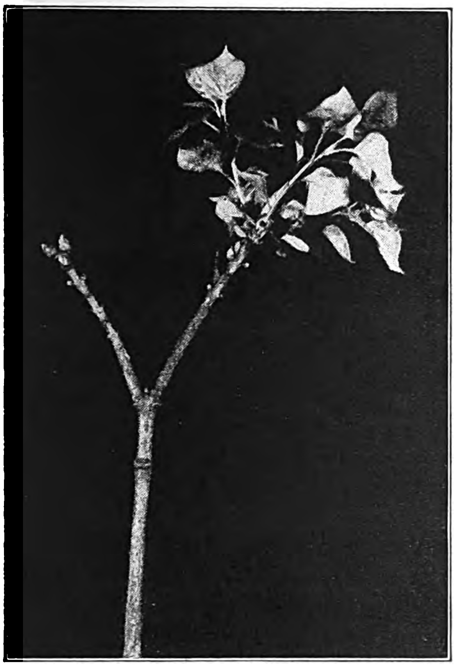


FIGURE 5.

Effect of treating a twig with chemicals and leaving an adjoining twig untreated

Figure 1 shows the results produced by soaking the potatoes, previously cut in pieces for planting, in a 1 percent solution of sodium thiocyanate for 1 hour and planting the soaked pieces at once without rinsing. Two methods of treatment with ethylene chlorohydrin have proved successful—application in solution and as a gas.

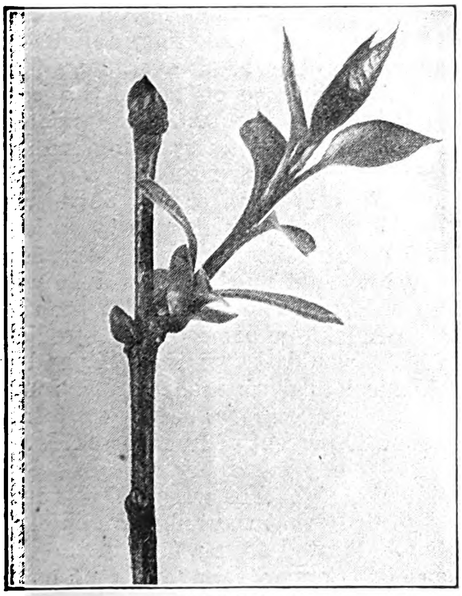


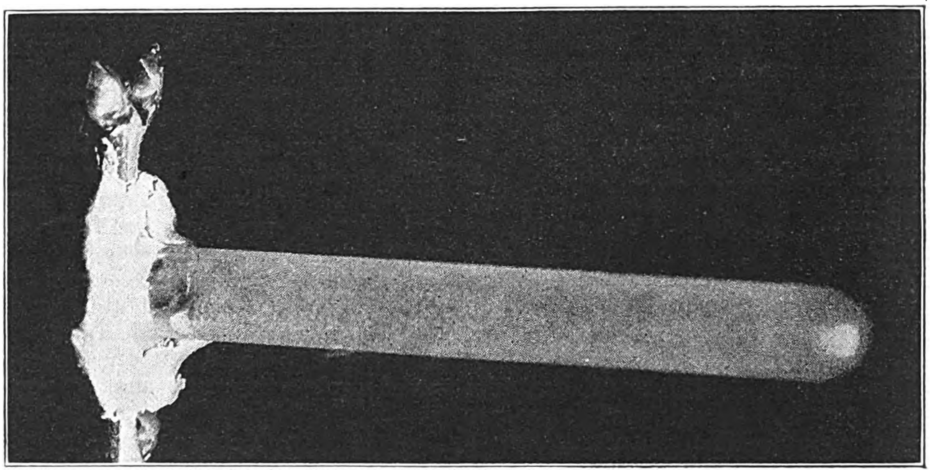
FIGURE 7

While its companions slumbered, this bud grew in response to exclusive treatment

In the first method, or "chlorohydrin dip," the cut pieces are dipped into a solution made by mixing 30 cubic centimeters of 40 percent ethylene chlorohydrin and 970 cubic centimeters of water; then storing them in closed containers for 24 hours and planting. Figure 2 shows results obtained by this method.

The vapor treatment may be used on the whole potato by placing the seed potatoes in slatted crates in a room that is approximately air-tight. From one quarter to one gallon of 40 percent ethylene chlorohydrin per 1000 cubic feet of space is evaporated into the room by means of an electric fan, and the potatoes are allowed to remain in contact with the vapors for 24 to 28 hours. Potatoes thus treated when removed from the gas room and allowed to stand in air at ordinary temperature will develop sprouts in 7 to 10 days.

As far as the cost of treatment by either method is concerned, this should not exceed five or ten cents per bushel of potatoes. Although sodium thiocyanate is poisonous, its handling involves no more danger than the handling of poisonous insecticides and if the treated tubers are protected from animals and the left over solution promptly disposed of, there should be no hazard in its use.



All illustrations courtesy Dr. F. E. Denny, Boyce Thompson Institute for Plant Research, Inc.

FIGURE 8

By sealing the test-tube to the twig, only a single bud is exposed to the vapors during the treatment, enabling the scientist to gage accurately the effect produced by the fumes

Another remarkable effect in the germination of potatoes is that of greatly increasing the number of sprouts per seed piece by soaking the pieces for one hour in a 2 percent solution of thiourea. This results in a larger number of *smaller* potatoes per hill, which is desirable in raising tubers for seed.

Ethylene chlorohydrin and ethylene dichloride have been found to "awaken" such woody plants as lilac, crab-apple, Deutzia, et cetera, from the rest period that ordinarily postpones their flowering in hot-houses until February, so that they bloom before Christmas. The plants are placed for about 24 hours in a closed chamber in which a measured amount of the chemical is evaporated by means of an electric fan. About 10 cubic centimeters of 40 percent ethylene chlorohydrin solution per 100 liters of space give favorable results with most species, although some species respond to as little as 0.75 cubic centimeters. Ethylene dichloride in like amounts is equally effective. In the case of Deutzia, illustrated in Figure 3, strong concentrations of vapor cause the buds to develop more leaves but fewer flowers while low concentrations seem to produce flowers at the expense of leaves.

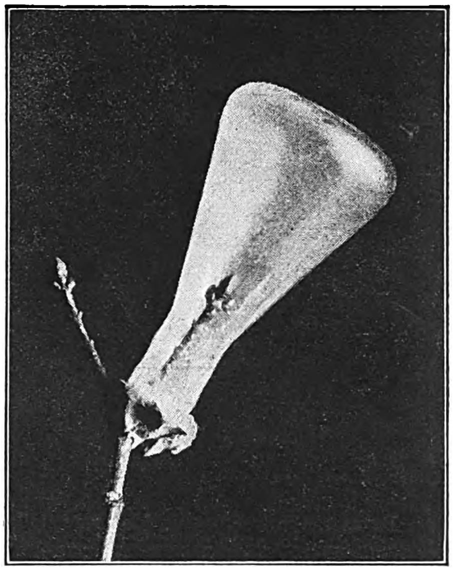
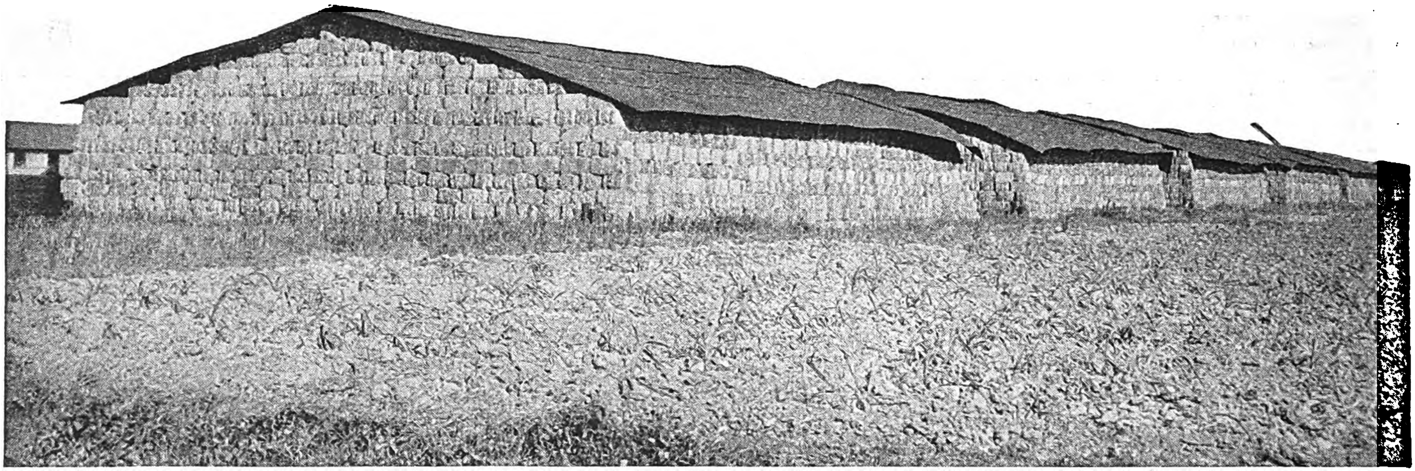


FIGURE 6

Illustrating method of treating part of a plant without exposing an adjacent branch

Figure 4 gives convincing evidence of the effectiveness of treating a lilac plant. Figures 5 to 8 clinch the demonstration by showing how a single twig or a single bud on a twig responds to the stimulating vapor.



All photographs by Ewing Galloway

SUGAR CANE WITH THE SWEETNESS GONE

Bagasse, the trade name for sugar stalks after the syrup has been extracted, formerly not only represented a huge economic waste, but there was the problem of disposing of it. Now converting it into wall board for buildings is one of the largest industries in Louisiana

A Use for Everything

Finding A Sale for Products Which Heretofore Have Cost Money to Dispose of, Is the Newest of Professions

By MILTON WRIGHT

HERE is a man whose business it is to find a use for everything. In every industry there are chips, or dust, or scraps, or leavings of some kind which are thrown away. It is the business of this man to convert that waste into a useful product, to find a market for it where real money will be paid. The waste trade in this country is a billion dollar industry. It is constantly being added to by finding new uses and new markets for waste of all kinds and descriptions, a fact which has provided Theodore E. Koke, engineer, with an opportunity for a novel type of business.

We sought Mr. Koke and asked him to tell us how he happened to get into such a unique line of activity and to tell us some of the ingenious uses to which he has put material which heretofore has been destroyed or sold at prices far below its real value.

"I WAS with the United States Rubber Company several years ago and was put in charge of their salvage department in the Detroit plant," said Mr. Koke. "My job was to see that any waste products we had were sold. What was saleable seemed to be pretty well established, and the market and the price were pretty much standard.

"One of the things we were doing was to reclaim rubber from rubberized fabrics. We would take textile articles impregnated with rubber and remove the rubber with acid. The refuse of the textiles did not seem good for anything and we were flushing it into the river. I got to wondering if we could not find a use for it and at last it occurred to me that it ought to be good for chip-board. Chip-board is paperboard somewhat heavier than cardboard and is used for boxes and things of that sort. I visited a number of factories and offered to sell them all the material they could use for making chip-board articles, but none of them would have my leavings from the rubberized fabrics.

"One day, I walked into the manager of a factory and said: 'I am sending you down a carload of ideal material to make chip-board out of. There is no charge for this; I am making you a present of it. If you find that you can use it, we can talk business when you are ready for the next carload.' The result was that we received an order from that firm. None of that refuse has been wasted since."

"NO WASTE IS NECESSARY"

So says T. E. Koke, and he has made a life work of proving it to manufacturers

"But that is an extraordinary experience, isn't it?" we asked. "It was just a fortunate circumstance that the opportunity to dispose of a waste product happened to lie there; it was unusual."

"No, it wasn't. Here is another item.

"In every clincher type rubber tire, there is what is known as a bead. This is the little edge which fits on the rim. In making the bead, there is what is known as the bead overflow. This must be trimmed off before the bead goes into the tire. At the particular time of which I am speaking, rubber was worth about 28 cents a pound and it was cheaper to burn this bead overflow than it was to reclaim it for the rubber content. Obviously, there was not much we could do with the rubber, but it seemed to me that there might be some other ingredient which would be useful. I had a chemical analysis made and I found that these rubber strips contained about 30 percent of free zinc oxide.

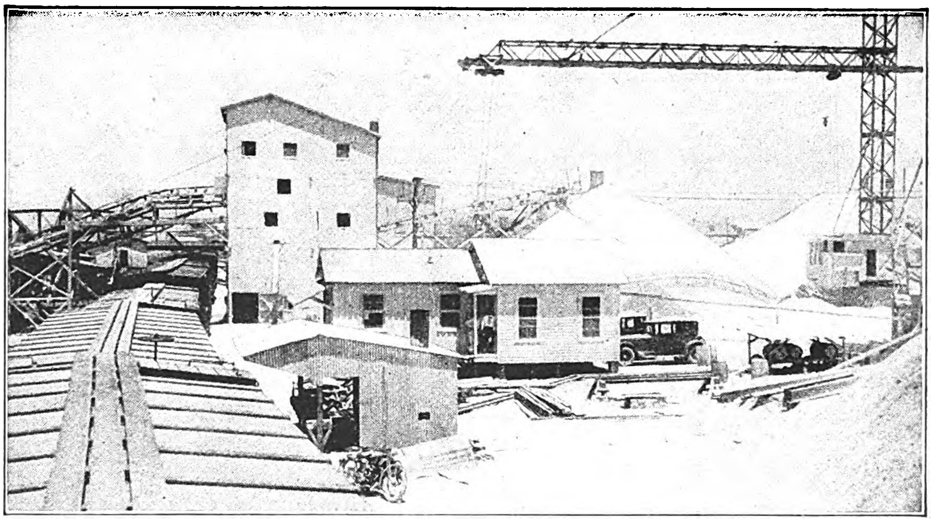
"THE job then was to find somebody that wanted zinc oxide. I finally located such a user in the Anaconda Copper Company's plant at Akron. They bought all I could supply them with, which amounted to more than 100,000 pounds a month.

"The next thing I took hold of was some short ends of tin-coated piano wire. Such wire was used as a wire bead in the straight-side type of automobile tires and the accumulated short pieces which were cut off amounted to a tremendous quantity. What to do with them was a problem. I finally managed to sell the entire surplus to the Vulcan Detinning Company of Pittsburgh. There was no reason why they should not reclaim tin from our wire as well as from old tin cans."

"Do you not find it rather difficult in some cases to find an outlet for a waste product?"

"Oh, it isn't easy. There wouldn't be any fun in it if it were. This thing of finding new uses for old wastes has become a sort of hobby with me. So many times have I been met with the objection 'It can't be done,' and so many times was I able to say 'I told you so,' that I adopted the slogan 'There is a use for everything.' I began to search out new uses for hitherto useless articles, not only because of the money involved but also for the pleasure I found in it.

"RUBBER was being received at our plant in 300-pound bales, each of them wrapped in a pouch of burlap. These burlap pouches were being sold at 12 dollars a ton to be used in the manufacture of roofing paper, which is about the cheapest paper made, for it contains almost anything and everything. The pouches or bags were almost new, I found. The shipment of rubber had been the only use to which they had been put and I wondered why they could not be used again without converting them into something else. I found out they would be admirably suited to shipping bales of cotton. Cotton shippers agreed with me, with the result that we sold the burlap pouches for seventy dollars a ton, delivering about thirty tons a month.



WEALTH IN OYSTER SHELLS

The value is not gone after the pearl, if any, has been extracted, the bivalve eaten and button disks cut out. What is left is crushed here for use in the building of highways

"Waste products are sometimes put to strange uses. I remember that it was quite a problem to dispose of the small size rubber tires. I made a survey of possible markets. At the Department of Commerce in Washington I learned that Spanish manufacturers were importing used tires of the smaller sizes, cutting them up into short lengths, putting a plug in each end and a strap across the middle and selling them to the Spanish peasants for sandals. They retailed at 33 cents a pair. I made a deal whereby we disposed of all our small-size tires to be used for this purpose.

"FOLLOWING this deal, the United States Rubber Company gave me a five-year contract and asked me to handle the salvage of the entire tire division which included the G. and J. Tire Company of Indianapolis, the Hartford Rubber Works at Hartford, and the Morgan and Wright factories at Detroit.

"With the making of some of the truck type of tires, a metal band was used. In reclaiming these tires, the rubber was taken off and the iron band was left. What could be done with it? I had this metal analyzed and found that it had a low phosphorous content. Such a metal would be in demand because it had a high re-melt value, and we could get a premium by selling it to companies making steel castings.

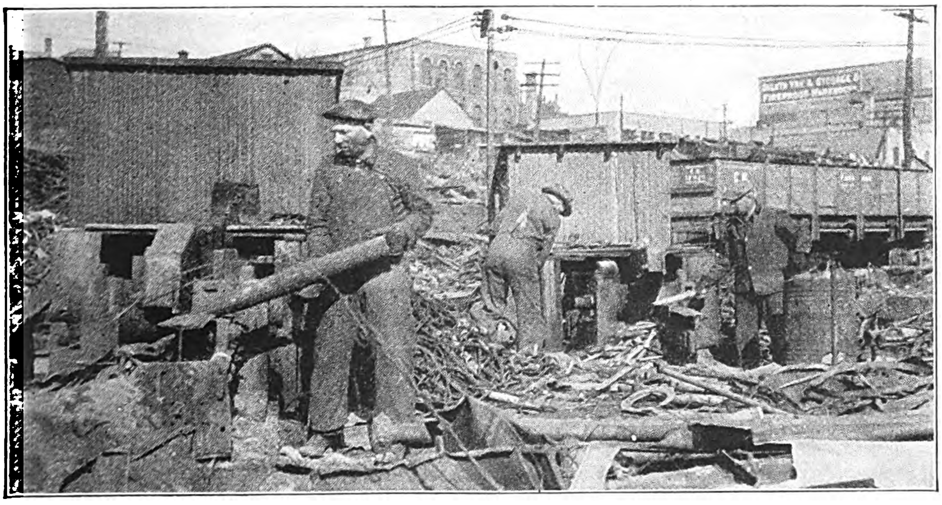
"In the Indianapolis plant, the inner tubes were wrapped with a strip of cloth, three or four inches wide, known as wrapping tape. By selling these to companies making roofing paper, we were receiving one cent a pound. I wondered if they could not be put to more valuable use. It occurred to me that possibly they could be used for making rag rugs, and I found a carpet company that could use this material. I sold them the discarded wrapping tape for seven cents a pound. Although there was only one carload a month, this was a jump of 1800 dollars."

"THE secret of making money from salvaging, you would say, lies in finding a new use for your refuse?"

"Not necessarily. The value of waste material, I have learned, can be multiplied by proper segregation. In many plants it is the custom to throw all of the scrap metal into one pile. By segregating these scraps of metal and selling them separately, a tremendous increase can often be effected in the price received for the scrap.

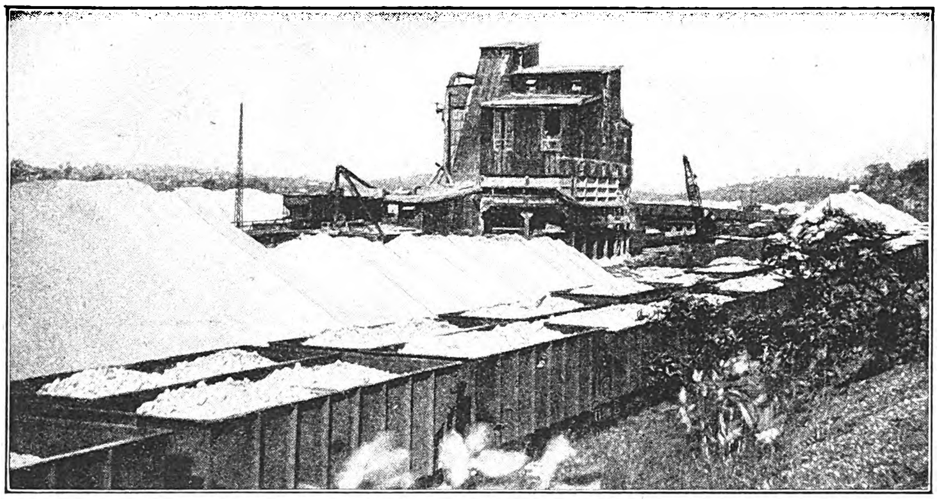
"Waste paper is a problem everywhere. In some plants I was investigating, I found that much waste paper was being burned. The rest of it was being sold in bulk. Now, some kind of paper is worth one price and another kind is worth an entirely different price. By making inquiries of various manufacturers, who were using waste paper in the making of their products, I learned that I could get 40 dollars a ton for kraft paper, 12 dollars a ton for newsprint, and so on."

"But would it really pay you to do



LITTLE ONES FROM BIG ONES

Scrap metal is handled more easily when cut into small pieces. The worker places the iron on the bar and a heavy shearlike weight severs it as easily as thought it were a piece of paper



SLAG FOR ROADBEDS

From the blast furnaces of western Pennsylvania the mineral smelting refuse is carried to Rusher, Pennsylvania, where it is prepared for use on highways and in filling railroad beds

that?" we interrupted at this point. "Is there not a labor cost involved which would outweight the added price you would receive for your waste paper?"

"We always figured our labor cost before determining whether to make any change or not. Some people spend ten cents in order to reclaim a five-cent item. If the cost of reclamation is greater than the price received for the reclaimed object, naturally it is not worth reclaiming it.

"All sorts of things can be reclaimed. Take cinders, for example. In a Detroit plant, 15,000 cubic yards of cinders a year were being accumulated. For these the manufacturer was getting seven cents a cubic yard. I recalled that I had heard something somewhere about 'cincrete block,' a product in which cinders were mixed with concrete. There was a possibility of selling our cinders for this purpose, at 40 cents a cubic yard.

"THE problem was not completely solved even then, however. A further search for markets developed one in the realty subdivision field. By finding out the prices cinder contractors were getting, and by taking over the handling costs, it was found that a price of a dollar a cubic yard could be had and would yield a legitimate profit. A long term contract was entered into to protect the manufacturer from the difficulty of disposing of his cinders in the winter when the demand for them is not great."

"How do you get on the trail of particular waste products?" we inquired.

"It is the easiest thing in the world," he replied. "Everybody knows of something going to waste. You can not start a conversation on the subject without being informed of some new waste product that you had not heard of before. It is a delicate matter, however, to discuss with a man the waste there is in his own business. Nobody likes to admit that his own industry is producing any waste. That would seem to imply a lack of efficiency in operation. In discussing it with an industrial executive, you generally have to lead up gradually to it and let him discover for himself that possibly something can be done with all that refuse on the dump.

"HERE is an example of a waste product which is just about to find a new use. For more than a hundred years, a well-known company has had a waste product consisting of tough fiber. Recently it has amounted to about 1500 tons a year. It occurred to me that this waste fiber might make an ideal filler for certain commodities. If so, it could be provided in such quantities and at such prices that it would be widely used. I have sent a research man to work to ascertain if my hunch was a good one.

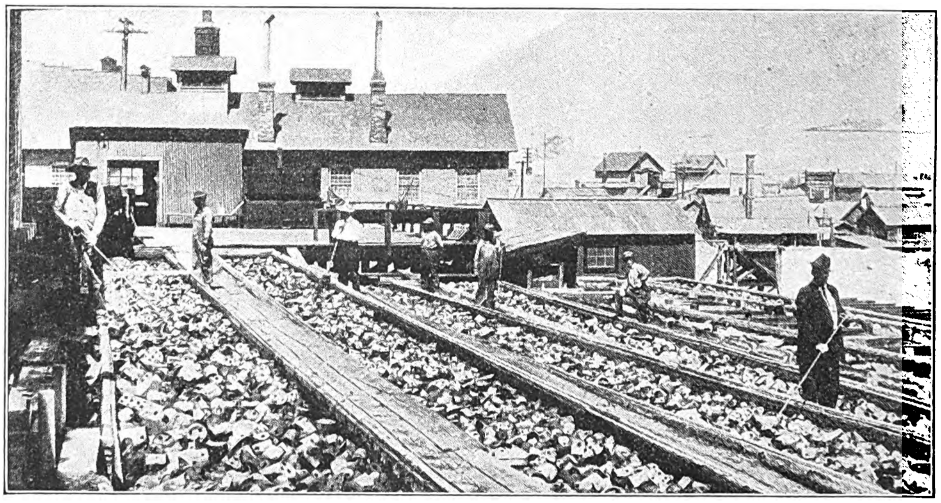
"Here is another. A large canning industry, I am told, has millions of gallons of fruit juice pumped into convenient creeks. How true this is, I do not know. When I get time I shall look into it. If the canneries are wasting any juice, I shall try to find a use for it.

"Recently I have been making a canvass of manufacturers, and the rapidity with which items of waste are reported is astonishing. One upon which I have just started to work is the disposal of 150 tons daily of a chemical being pumped into a meadow by a large manufacturing plant. There are at least five possible markets for this product which I expect to develop within a short time.

"THE useful products already converted from waste seems miraculous—automobile lacquer solvents from what was once a waste product of our mid-west cornfields, wall board from corn stalks, Rayon from sugarcane stalks and a host of other things. It is a field, however, in which we have only scratched the surface. In time, reclamation of our waste products will become one of our biggest industries.

"I should say there is scarcely a manufacturer in the country who does not waste something. Sometimes the potentialities which lie in this waste mean the difference between showing a loss at the end of the year or showing a profit. One hundred percent efficiency is an ideal which few of us can attain but a lot of industries by a careful survey of their operations could approach far nearer to it than they do.

"We have wastes of many kinds—of idle machinery, of inefficient workmen, of cumbersome processes, of faulty cost accounting systems, and of a score of other things. There are men who specialize in each of these things. For my field I have chosen waste materials—refuse. That alone is a problem which will keep me busy the rest of my life and not myself alone, for I believe converting wastes into uses will become a highly specialized profession for many men."



MINING THE MINE WATER

At this Butte, Montana, mine, waste copper is reclaimed by using waste tin cans. Mine water is run into long tanks and the copper contained therein is precipitated by the tin

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WHEN MORE EFFICIENT LIFE-SAVING METHODS WERE NEEDED

A photograph of the *Vestris* as her passengers hastily donned life-belts and worked frantically to lower the boats as the ship listed prior to sinking off Virginia in November, 1928

We Offer a Medal for Safety at Sea

New Equipment Is Needed to Prevent Disasters and Loss of Life at Sea

THE tragic foundering far at sea of the steamer *Vestris* points to one thing above all others: the necessity for more efficient equipment for safeguarding ship passengers by preventing disasters and for saving their lives after some catastrophe has overtaken the ship on which they are traveling. From the mass of conflicting evidence that has been offered to explain the loss of the *Vestris*, many conclusions have been drawn but, whether or not any of these is anywhere near the truth, the fact remains that, had there been better devices for saving lives at sea, and had the ill-fated ship been fully equipped with them, it is possible that there would have been no loss of life.

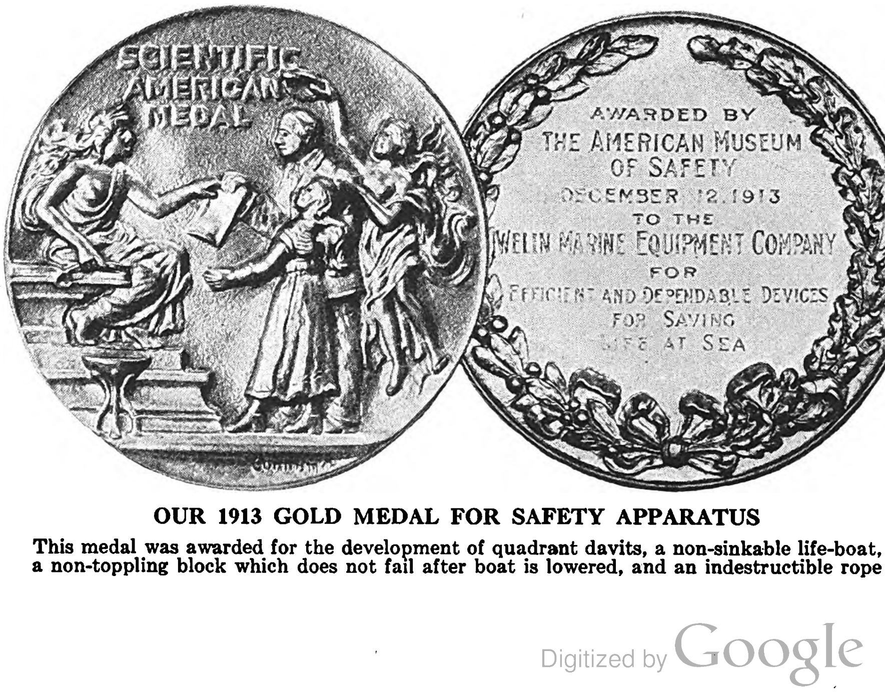
With this in mind and in order to stimulate widespread interest in the vital problem of safety at sea, the editor of SCIENTIFIC AMERICAN has decided to award the SCIENTIFIC AMERICAN Gold Medal for 1929 to the inventor, designer, or manufacturer of the new device, devices, or apparatus which, in the opinion of the judges, will embody the greatest factor of safety for ships of any kind or type, exclusive of ships of war. An individual or company in any part of the world may enter for consideration any piece or pieces of such equipment developed between the date of this announcement and September 30, 1929.

The competition is without limitation as to race or nationality.

IN announcing this gold medal award, the editor is establishing a precedent in offering it exclusively for sea safety devices. While SCIENTIFIC AMERICAN has always been interested in promoting safety in every line of endeavor, never before has it felt that there was so urgent a need for safety in one specialized field. Of the eight gold medals that have been awarded for safety, however, two have gone to marine equipment companies. That these two were victorious in an unlimited competition, indicates the magnitude of the problem and the possibilities of improvement. Shipping is our oldest large industry and, because of the innumerable unknown factors entering into it, is still about the most dangerous with the exception of the fledgeling industry, aviation.

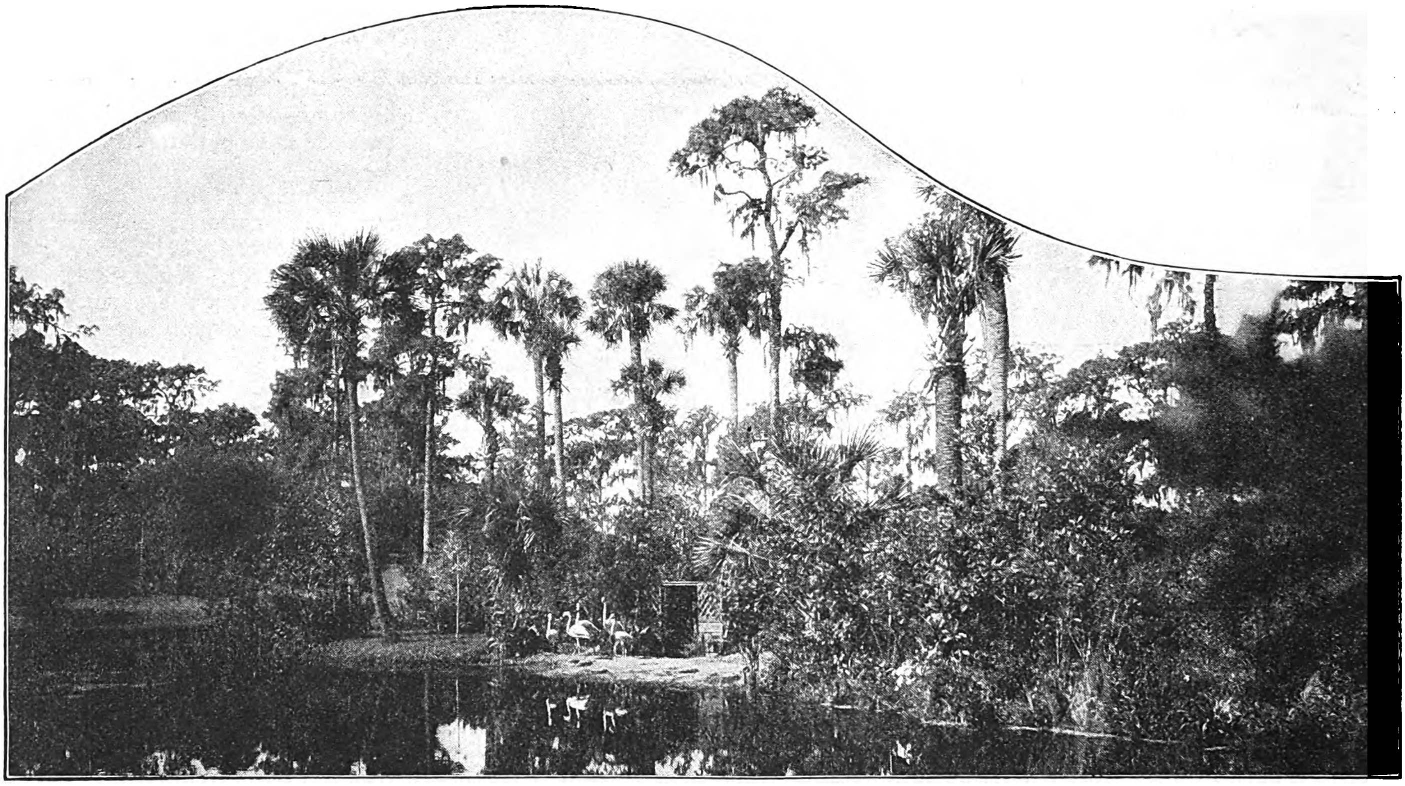
That the award of this gold medal for 1929 will be a peculiarly distinctive recognition, may be seen in the fact that none has been awarded since 1916. The device which merits it will, therefore, be an outstanding and noteworthy achievement.

The American Museum of Safety, 141 East 29th Street, New York City, has agreed to supervise the award of this medal. Between this Museum and SCIENTIFIC AMERICAN there has always been a fine spirit of co-operation in the promotion of safety. Due to our desire to make this announcement without delay, there was not sufficient time to complete certain details and announce them here. The Museum of Safety, however, will soon appoint the Board of Judges—most likely from among marine experts—and will arrange whatever further rules may be deemed necessary. These details will be announced in our next issue.



OUR 1913 GOLD MEDAL FOR SAFETY APPARATUS

This medal was awarded for the development of quadrant davits, a non-sinkable life-boat, a non-toppling block which does not fail after boat is lowered, and an indestructible rope



IN THE WILD-LIFE SANCTUARY

At the foot of the hill from which rises the "Singing Tower" with its beacon for birdmen is this beautiful lake, surrounded by tropical vegetation and constituting an ideal retreat for wild life. A group of flamingoes may be seen on the shore in the center background

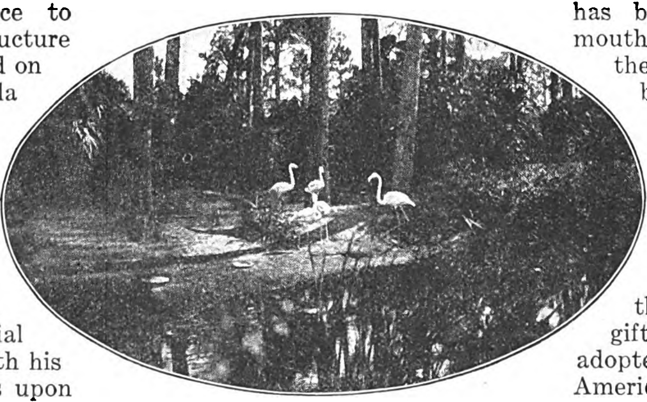
A Beacon for Birdmen

Lights to Guide Fliers Will Be Added to the Giant Bell Tower In Florida's Wild-Life Sanctuary

By L. B. ELLIS

ATOP one of the highest points in Florida, a bell tower of the Old World, carrying a powerful beacon for the aid of airmen, furnishes a curious mixture of old association and modern utility.

This magnificent campanile, or as popularly named "Singing Tower," just now completed, crowns the central Florida eminence known as Iron Mountain, rising to a height of 205 feet from its granite base. The menace to aviation from a massive stone structure of this type and altitude, erected on the highest point of the peninsula and carrying no beacon or warning signal, would be inconceivably great when, in the future, planes multiply and weave back and forth across the narrow strip of land. Consequently, E. W. Bok, who built and is donating to his adopted country this wonderful memorial edifice, has recently conferred with his architects and other authorities upon the matter, and now sanctions the announcement that the tower will carry a beacon to guard the airways.



A SEQUESTERED NOOK

Another corner of the bird sanctuary, and another group of flamingoes at home

The campanile is at Mountain Lake in the heart of the state's scenic highlands on the central ridge of the peninsula. One of the largest carillons of the world has just been installed in the tower—61 bells with an aggregate weight of 123,164 pounds. The big tenor bell weighs over eleven tons, and the silver-voiced baby of the lot only 16 pounds. The gamut of tones is 48, or four octaves, and the carillon is thought to surpass in power as well as fineness any other set of chimes now existent.

The bells were cast in England, at the famous old foundry of John Taylor and Company, Loughborough, where they have been casting world-famous chimes and carillons since the 14th Century. They claim that the formula for the composition of the metals and the tuning of the bells has been transmitted by word of mouth from sire to son through all these centuries, it never having been entrusted to writing.

The massive units have now been swung upward, some at an altitude of 140 feet, others 180 to 190. The dedication of the carillon and tower, together with the Mountain Lake bird sanctuary, will take place the first of February. They are a gift of beauty and worth from an adopted son to the great mother, America, who has given him success of no ordinary kind.

"Bok's Bells" the native Floridians call the carillon; and "Singing Tower" it is. The gentle-faced, elderly man who came over here a friendless immigrant lad smiles approvingly at both names.

"The tower would be *klokkenspel* back there in the Netherlands," he says, "for the great campaniles of the world, made, some of them, as the noblest architectural creations, have evolved from the old-world watch towers, carrying their big, clanging bells to peal forth a harsh alarm whenever the sentinels might espy from their battlemented tops either an invading foe, a broken dike or devastating fire. In this happier time and land, we have kept the tower idea, developing it into a 'singing tower,' its bells evolving into tunefulness—the whole creation a thing of beauty."

From time to time, one or another of the native folk, as he moves among the on-lookers around the splendid structure, will ask him, "You built all this just for your own pleasure, didn't you, Mr. Bok, because you have a winter home here, and want something different when you come down?"

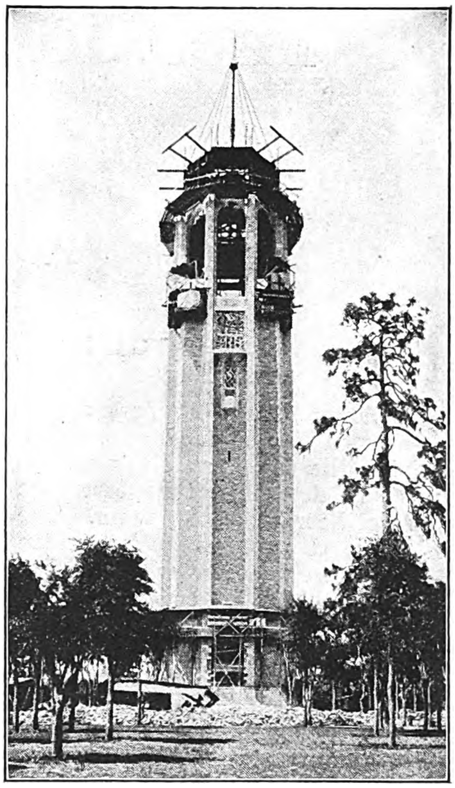
"BUT how little point," he answers, "to build a great beautiful structure like this, housing therein all that tuneful mass of metal, cast into wondrous shapes and gradations, all for the pleasure of one person!" If this seems to reach the listener with due force, he may proceed to expound his theory that this is an investment in beauty, because beauty is truth and both uplift the spirit. He hopes that in erecting the tower, placing in it the marvelous carillon and encircling them with the charming park and bird sanctuary, he has done something for future generations as well as the present, something that tends profoundly towards spiritual and esthetic gain for many people.

The tower is modeled on the lines of the campanile at Malines, thus continuing, in a way, the old-world tradition. But the dominant motif, in decorations, carving, and materials, is American; in fact, almost wholly Floridian. For structural strength the steel frame-work, anchored to a reinforced concrete mat, is said to be unsurpassed. The exterior is of pink marble from Georgia, and of picturesque Florida ocquina, making a harmonious whole that is the admiration of all who see it. Soaring upward more than two hundred feet from its granite base of 51 feet in width, with gradually changing form and tapering lines, the structure becomes octagonal towards the top, and little more than 30 feet in width.

THE Florida motif is especially noted in the grille of faience adorning the great lancet windows through which the melodious bell-notes are to travel outward. Here the development of life is suggested, from the undersea forms on through the flora and fauna of the state.

The carvings on the marble band encircling the tower, and on the pinnacles, replacing the usual ancient Gothic gargoyles, are of eagles, herons, flamingoes, and pelicans. One might easily suppose that Lee Lawrie, the sculptor in charge, had stalked the lake and woodland habitants of the sanctuary for his models.

An effect more pleasing can scarcely be conceived—a structure of such architectural charm, lifting to such height, under the turquoise skies of a summer land, with a landscape spread below, of orange groves, shining lakes, and splendid native forest growth of live-oak, magnolia, pine, and palm. Then to the natural beauty of the park, some fine landscaping has been added by Frederick Law Olnsted, Mr. Bok insisting, however, only on the enhancement which stops short of artificiality.

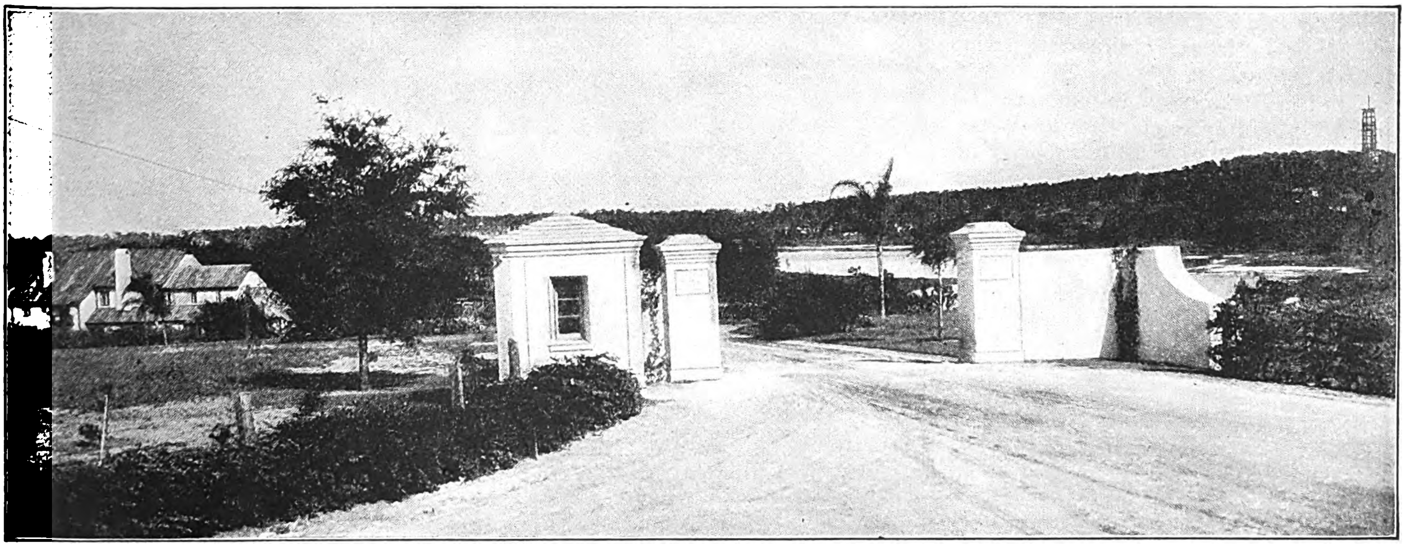


THE TOWER.

Constructional work on the shaft. See also frontispiece of this issue, page 104

In the park a few English nightingales are being Americanized at present, perhaps to listen in wonderment to the English chimes, when Anton Brees, the carillonneur, has come over to play them, as he is soon to do, being engaged as maestro at the Singing Tower.

Toward the ocean and the Gulf the music will be carried on the tropical breezes. The tower on Iron Mountain is 67 miles, as the crow flies, from the Atlantic, and a trifle over 70 to the nearest inlet of the Gulf of Mexico.



ENTRANCE TO THE BIRD SANCTUARY

This gateway is located at the Mt. Lake entrance to the area within which is situated the "Singing Tower." Photograph was taken when only the skeleton frame of the campanile was finished. Note it on the rise of ground (highest point in Florida) at the extreme right

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

The Deafened School Child

TWO years ago more than 1000 children in a New York school were tested by a modern method involving the use of an electrical apparatus to determine the percentage of loss of hearing among them. The method used involves an apparatus called an audiometer, which makes it possible to test 40 children at one time. Out of the approximate 1000 children tested in the two periods, about 80 percent were found to have normal hearing and from 5 to 8 percent were found to be deafened.

Re-testing indicated that about one third of all children selected by such methods as being deafened are found to be borderline cases. Moreover, the test shows that there are large numbers of children who are in this group whose hearing may be greatly improved with proper attention. Hence the investigators suggest that children in schools where some thousands of children are given routine tests be re-examined at fairly frequent intervals so as to prevent any child from being overlooked and not given the opportunity for recovery that comes with proper diagnosis.

Annual examinations of the hearing should be made, and special attention given not only to all children found to be deafened at the time of any single examination but also to all children who have at any time suffered infections of the ears. The evidence indicates that there are at least 3,000,000 deafened children in the United States.

Children between the ages of 15 and 18 years of age who have recurrent attacks of deafness three or four times a year and who recover from such attacks following proper attention to the nose and throat should have constant attention until the nose and throat conditions are cleared up. If not, they may inevitably look forward to a life of complete deafness in adult years.

Noise and the Public Health

IN a special report submitted to the Minister of Health of Great Britain, the British Medical Association has qualified all sorts of noises. An unnecessary noise and a public nuisance is any noise made at times of the day or night when it is most likely to be disturbing; any noise that is loud, screeching, strident, or discordant, and any noise that is discontinuous and unrhythmic.

A healthy person is capable of adapting himself to all sorts of peculiar conditions, but every adaptation causes a certain amount of wear on the nervous system. Investigators have found a definite relationship of unnecessary noises to loss of personal and industrial efficiency. Most noises occurring in industry are rhythmical, uniform and continuous; they do not involve sudden changes of quality, pitch, or intensity, nor occur so suddenly as to startle the hearer. Street noises are entirely different than noises taking place in industry. The sudden unexpected screech of a motor horn, the rattle of a wagon loaded with milk cans, or the explosion of a motorcycle exhaust is bound to irritate the nervous system.

The ordinary citizen needs a certain amount of undisturbed sleep. Hence it was determined that any noise from 11 p.m. to 6 a.m., which is capable of being prevented or lessened, ought to be included. The needs of the healthful individual are emphasized in the case of sickness. People who are nervous or who suffer from insomnia may be driven almost to the point of distraction by irritating and useless noises at night. In its consideration of the subject, the British Medical Association classified among preventable noises the following:

(1) Inefficiently silenced motor vehicles.

(2) Warning instruments carried on motor vehicles; particularly strident horns and electric hooters.

(3) Barking dogs.

(4) Cries and bells of street vendors.

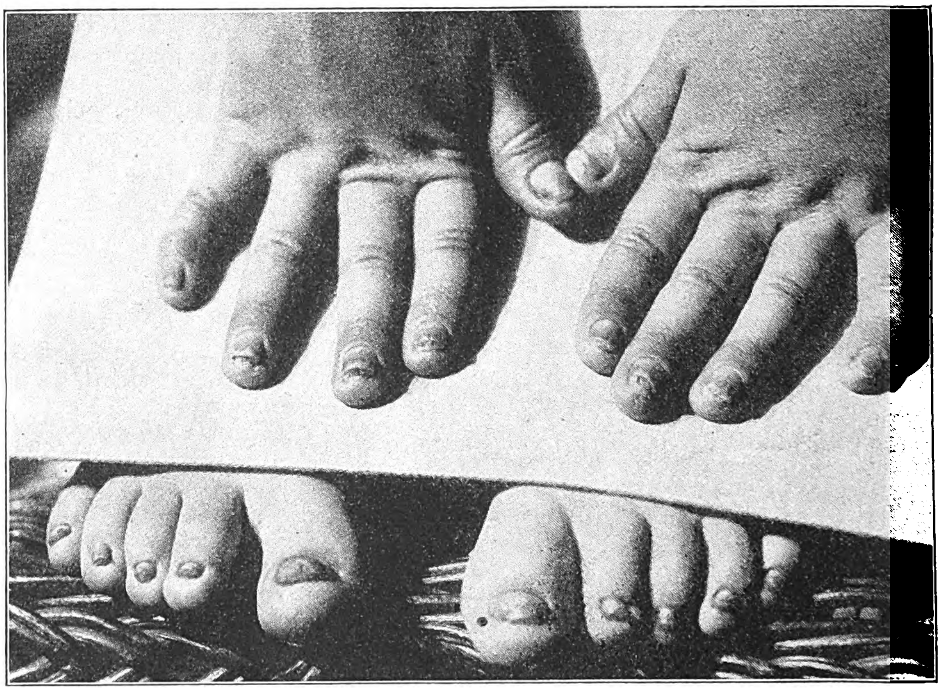
(5) Careless handling of milk cans.

(6) Noises on railways.

It suggests control by law of some of these noises and education of the public in the control of noise.

Inherited Changes in the Finger Nails

CERTAIN diseases affecting the finger nails and the hair seem to occur regularly in families. In a case recently described by a physician of Seattle, the finger nails were normal at the base but increased in thickness toward the tips. They were very brittle and dry and because of their condition became easily infected and



INHERITED CHANGES IN FINGER AND TOE NAILS

This example of dry, brittle nails occurred in the fourth generation. Treatment was found to be without effect, the annoying condition being established as hereditary in character fell off. The heredity of the child was traced. It was found that one great-grandparent was affected. Of this family, 13 children were born, of whom six had the disease. In the next generation there were 26 children of whom five had the disease, and in the next generation 25 children of whom four had the disease. Thus 16 out of 65 in four generations were afflicted, 11 of them boys and five girls.

Treatment was without effect, since the condition seemed to be definitely related to some hereditary disturbance.

Paralysis of the Kaiser's Arm

AN investigation of the available literature indicates two possible theories as to how the arm of Wilhelm Hohenzollern, the last of the kaisers, became paralyzed. One story has it that the birth of the child was difficult and that he suffered with what physicians call an obstetrical paralysis. According to that report the child hovered between life and death for more than an hour and a half before the pendulum swung definitely toward life. On the third day it was discovered that the left arm was paralyzed, the shoulder socket torn away and the surrounding tissues severely injured. No doctor would venture surgical operation for repair.

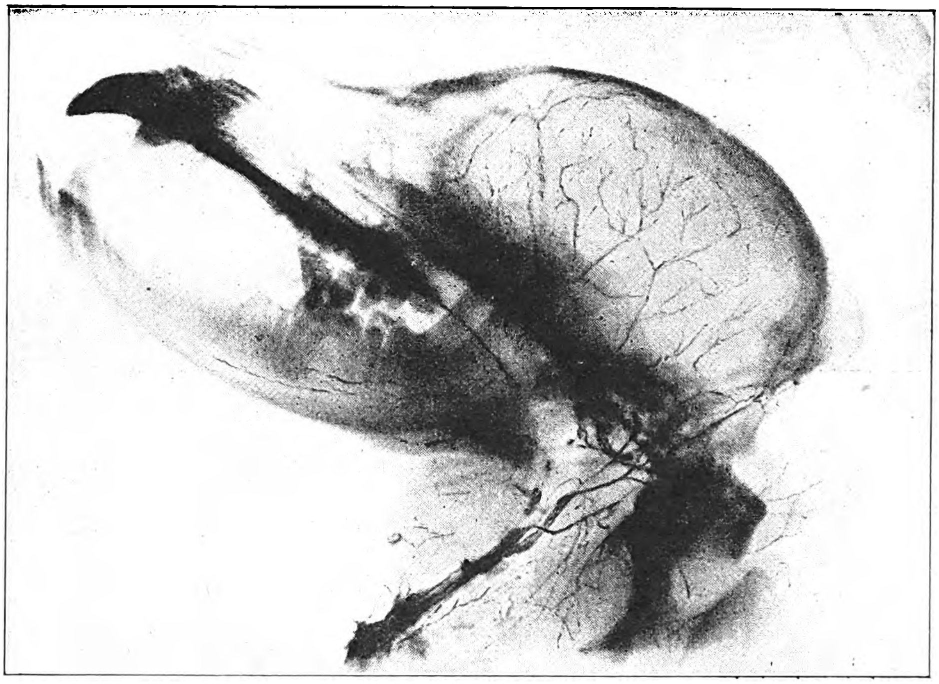
The second story has it that the mother, the Crown Princess Frederick, took the child with her on horseback when he was two years of age and dropped him. After about three weeks it was discovered that the arm had become paralyzed.

The evidence is not clear in either case, but the first story seems more probable.

Changes in the Blood After Ultra-Violet Ray Treatment

MANY of the claims made as to the value of ultra-violet rays when applied to the human body have to do with effects that would be secondary to improvement of the general quality of the blood, so far as relates to the number of red and white blood cells. It is already well established that exposure of the body to ultra-violet rays does profoundly affect the system and it is necessary therefore to have a complete understanding of these effects before physicians will be able to determine the proper dosages under various circumstances.

Some investigators have shown already that the exposure of dogs to the rays of the carbon arc is followed sometimes by an increase in the number of red blood-cells and sometimes by a decrease, but with a tendency toward increase rather than decrease. Apparently the rays stimulate the bone marrow and other blood-forming organs to form new red blood-cells.



SHOWING THE CIRCULATION OF BLOOD

After injecting into blood vessels five cubic centimeters of iodized rape-seed oil, diluted four to one with ethyl olive oil, X-ray photographs will show the blood circulation, as above

Two other investigators have shown recently that following exposure of animals to the ultra-violet rays, there is also an increase in the fluid matter of the blood which disappears after a few hours. Repeated exposure to the rays stimulates the blood-forming organs to produce an increased number of red blood-cells which persist for several weeks after the last raying. However, the newly formed red blood-cells are usually smaller than the ordinary red blood-cells, and associated with this there is sometimes apparently a lessened number of white blood-cells. Massive doses of the rays are apparently capable of destroying red blood-cells.

This evidence indicates the need for extensive study and careful investigation of the effects of the rays before people begin to use them without careful supervision. Every potent force in medicine is a two-edged sword capable of doing harm under wrong conditions, as well as good under proper conditions.

Visualizing the Spine

IN 1923 two French professors reported that the injection of poppy-seed oil into the spinal canal would enable visualization by use of the X ray. Recently American observers have given special attention to the use of other substances. Drs. Frazier and Glaser have found that rape-seed oil when iodized is preferable to the poppy-seed oil because of its low toxicity and non-irritating properties. If it is prepared with sufficiently low viscosity, it will flow easily through a fine needle and distribute itself thoroughly in the spinal canal.

It was also desirable to find some substance which could be put into the blood vessels so as to permit visualization of the blood vessels in the brain, a procedure of great importance in the diagnosis of certain brain diseases. Such a preparation was worked out and tested experimentally on animals. Apparently it was possible to inject small amounts of this substance into the blood vessels without any ill effects to the animal. As shown in the illustration, it is possible to visualize the circulation of the blood in the brain and to obtain an outline of the brain structure.

Airplanes to Control Mosquitos

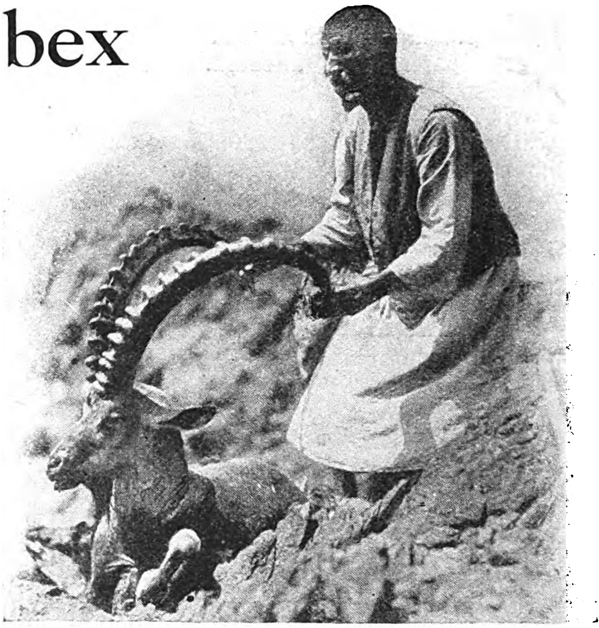
THE attempt to rid marshy areas of pestiferous anopheles is a problem that has constantly disturbed the public health worker. Drs. S. S. Cooke and L. L. Williams, Jr., of Virginia, have developed a method involving the use of the airplane which they insist is commercially feasible. A mixture of 33 percent of Paris green in an inert dust is taken up in the airplane and sprinkled over the involved areas, one pound of Paris green per acre being considered a proper unit.

At Quantico they sprinkled the infested areas in periods varying from six to 13 days. It was found that Paris green-soapstone mixtures, when distributed by airplanes, will penetrate all forms of vegetation indigenous to the Atlantic seaboard. The dust is put into a simple box with sloping sides which may be opened when distribution is begun. One airplane can cover 20 square miles of breeding surface, and the material costs approximately 70 cents per acre, per season.

With "Fuzzies" After Ibex

Scientists Turn Big-game Hunters as They Pursue the Elusive Ibex In the Red Sea Hills of Sudan

By H. E. ANTHONY
Curator, Department of Mammals, American Museum of Natural History



A NUBIAN IBEX

One of the animals bagged above the Khor Sharag by the expedition described in the text herewith

WHEN Irving K. Taylor, who had made three trips into the Anglo-Egyptian Sudan, decided upon a fourth visit, he planned for something more than the usual sportsman's jaunt and offered to finance and conduct an expedition for the American Museum of Natural History of New York City. It was a splendid opportunity for the Museum to secure much needed specimens of the fauna of the Sudan. The region of the upper Nile was very poorly represented in the American Museum, and valuable results were certain to follow an acceptance of Mr. Taylor's offer. It was my good fortune to be sent with Mr. Taylor as the Museum representative and naturalist and to be his companion on a trip which lasted from December, 1926, into June, 1927, and took us over nearly 4000 miles of the Sudan.

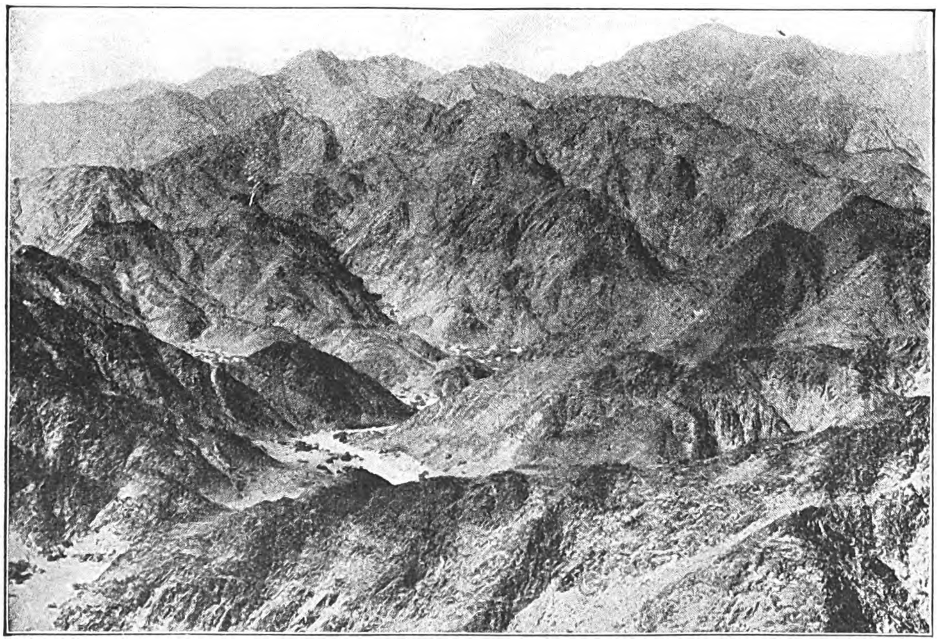
Of the many interesting experiences which came our way none impressed me more than our hunt for the Nubian ibex in the Red Sea Hills. We had spent the first three months of our time from Khartoum southward on the White Nile collecting many specimens of mammals, birds, and fishes. There were many high-lights which stood out from the everyday routine, such as a close call from a charging buffalo, our success in getting good photographs of the whale-headed stork, and the capture of one of the huge Nile perch. But our experiences with the natives of the Red Sea Provinces, the "Fuzzies," will always be one of the choicest recollections of my first African expedition.

TO reach the ibex country we went by train from Khartoum to Port Sudan and then by a short spur line to Suakin. A Ford car and motor lorries brought us and our outfit to Tokar where our camel caravan, or *hamla*, was assembled. Tokar is the center of a rich cotton district, and during our brief visit an annual agricultural show gave us a chance for some unusual pictures. When we left Tokar we struck across a bare and inhospitable desert and on the third day reached the first of the Red Sea Hills. Several days more were required to arrive at the camp site which our head guide had designated for us and then the hunt for ibex was on in earnest.

A blazing sun had slowly crossed a sky of brass, and shadows were lengthening behind the rocky, heat-shimmering ridges when our two guides came up to the tent where we sat cooling off after our four o'clock tea, brought their heels together, and saluted in military fashion. Osman, our official interpreter, was lying on his back in the cook tent, his leg swollen from the bite of some venomous creature, a scorpion perhaps, or possibly a snake, but we hoped for his sake it was not the latter. The night before, he had stepped on some unknown thing in the dark and now was beginning a two weeks' period of helplessness.

WE soon learned, by mixed Arabic and English, that our guides knew where we could expect to see some ibex. Our auxiliary forces, the "Fuzzies," had scouted over the hills and reported favorably. We would get up at three o'clock in the morning, the guides said. This aroused no wild enthusiasm, but if it was part of the game we would do it. After a few questions, the conference came to an end and the guides went back to the native section of camp.

It seemed as though three o'clock came as soon as we had fallen asleep, and if the ibex chose such an hour to be on the move we understood why so few sportsmen go after them. About four o'clock we filed up the sandy floor of the Khor Mashail, the cañon where we camped, and a mile or so above entered a tributary *khor* (stream-bed or ravine) and headed for the *jebels* (hills) above the Khor Shalalta. We took station with the two guides on a



All photographs courtesy Taylor Sudan Expedition, Amer. Mus. Nat. History

KHORS AND JEBELS

This view of the country through which the author hunted gives an excellent idea of the habitat of the Nubian ibex. The difficulties encountered are readily imagined promontory which commanded a vast enclosed amphitheatre and the sun had not yet appeared as we selected places where we would be hidden against the rock.

THERE are two ways to hunt ibex in the Red Sea Hills, neither one of which is easy on the hunter. One is to climb the ridges and stalk the animals where you find them; the other is to climb up where ibex are likely to pass and then send native beaters out to drive these wild goats past the points where the guns are stationed. While the latter method may sound like a tame procedure, this is by no means the case, for the ibex are wary and it is no small achievement to kill a "billy" even if it has been driven down from some more remote fastness.

For beaters we employed the native inhabitants of the hills, the Hadendoa or Beni Amer, the "Fuzzy-Wuzzy" of Kipling's poem. The "Fuzzy" is a splendid, picturesque type of Hamitic stock, with a huge head of hair which he dresses with grease, so that he greets the nostrils at about the same range as a flock of his own sheep. He is a mountain climber *par excellence* and about the only human being who can dislodge and press after a stubborn ibex. We had nine "Fuzzies" to beat the sky-line ridges and eight camel drivers to take up posts on the lower divides and turn the quarry in toward the hunters. Several hours are required to surround an area and get the ibex started for a given post, and on the morning in question we saw and heard nothing until the sun was above the horizon.

A faint tinkle of sliding rock at last drew our attention to the slopes of the rocky hill to the northeast. Three gray-brown animals swept around the brow of the jebel and, after a short run, stopped and watched the eastern sky-line. With our glasses we could see that they were ibex, but they were so far off that we could not judge the size of their horns. Furthermore, the light was still poor, for the sun was low, and there were great patches of dense shadow where the hollows lay under the peaks. Presently a "Fuzzy" topped the crest, following the track of the band, and then other "Fuzzies" bobbed up along the encircling ridges. The drive seemed well in hand.

SHOUTING to one another, the beaters pressed after the ibex, which lost little time in seeking escape in the only direction left open to them. The animals tracked along in single file and with a marvelous sure-footedness, seeming literally to pour themselves across the steep slope into a shadow-filled ravine, at no time coming nearer than 500 to 600 yards from our stand. The beaters circled rapidly, cutting off escape on the far side of the rocks where the ibex had gone, and then tried to turn the animals in our direction.

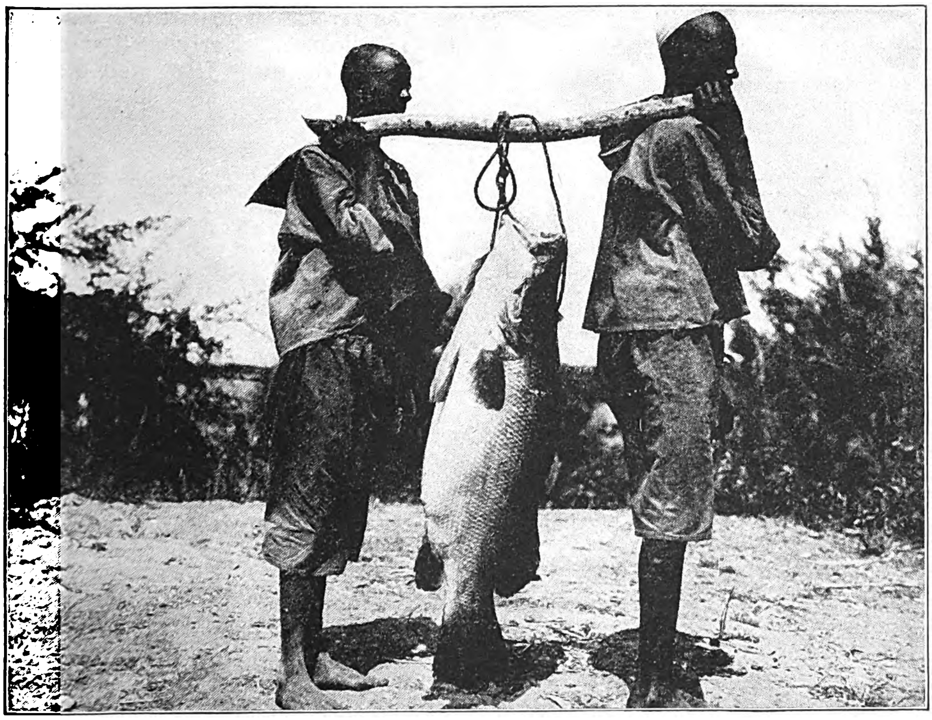
On the still air of the dawn sounds carried far, and the noise of the small, dislodged stones was audible for half a mile, while one must needs have been deaf not to have heard the shouts of the "Fuzzies" and the avalanches of rock which they sent cannonading down the mountain-side to stampede the suspicious quarry. The ibex did not want to be driven, and when they could not break through on the side they desired, they became stubborn and refused to move at all. On a later occasion I watched an ibex through my binoculars (the animal being unaware of my presence) when it was not in the mood to drive, and saw it go into a hole under a large rock, where it calmly remained, ignoring tumult and loose rock, until the men themselves were almost up to it.

"FUZZY"

This particular morning the beaters shouted to one another and converged upon the Jebel Shalalta with all their forces. "Fuzzies" hurrying up from the rocky ridges to the west drove out two hyenas before them. These big, dog-like carnivores trotted silently down a ravine and lost themselves in the gloomy depths of the Khor Mashail. I was glad of this glimpse of them, for on our first night in the khor we had heard the cavernous howl of a hyena reverberating up the valley, an ominous sound suggestive of great power—sonorous and sinister.

THE "Fuzzies" shouted "Ao, ao, ao," their name for the ibex, and ran along the rugged crests in sure-footed abandon. One native in particular had a great full-throated bass and when he poised on some precipitous crag, peering into the long shadows below, his bushy hair giving him the appearance of some unnatural being, I thought to myself, "What a setting for the Peer Gynt Suite." When his rollicking "Ho, ho, ho, ho" rolled in great waves of sound through the rocky defiles, then indeed he became a gnome in the "Hall of the Mountain King."

The three animals we had first seen soon returned across the *talus* opposite us, but now we had little attention for them, for we could see in the better light that they were females or young males—not a good head in the lot. The natives were calling that a big "billy" was still lurking in the shadows and that we were to keep an eye open for his appearance. After thirty minutes of pandemonium, when shouts and crashing rocks aroused nothing more substantial than echoes, the "Fuzzies" walked into the deepest recesses and drove the ibex out into view. He was a splendid animal with great sweeping horns. Too far for a shot, he made a rather leisurely exit across the slope just below the crown of the *jebel,*


FROM THE WATERS OF A SUDAN LAKE

Ibex are not the only lure for the sportsman in the Sudan. The author's party succeeded in capturing this remarkable specimen of the huge Nile perch. It weighed 45 pounds

WHALE-HEADED STORK

This queer-looking bird was encountered and photographed on the Bahr-el-Arab

stopping frequently to look back at the vociferous beaters and disregarding the rock dislodged from above in the hope of turning him down into the floor of the ravine.

The ibex understood falling rock, and neither the demoralizing din of its fall nor the actual striking of missiles near him caused him to hurry. He went just where he wanted to go, broke through the cordon at the spot where ibex had first entered the picture, and left the Jebel Shalalta. Our morning's hunt had bagged for us only experience, but that alone would be worth the effort it cost, and the ibex had certainly deserved his escape by his refusal to be "rattled."

WE soon learned that we could discount the native zeal for early rising. When our head guide, Mohammed Ali (called "Ali Kebir," "the big Ali," to distinguish him from other Alis in camp) said three o'clock, we said four and stuck to it. Upon one such morning the moon saw us mount our groaning camels and pad noiselessly down the *khor* for the Jebel Gadem, an hour or more to the west. Upon this occasion we took up separate posts, and in due course of time a good male was started. The regular program followed, a noisy convergence upon the spot where the "billy" insisted upon hiding, the failure of crashing rock to demoralize the animal, and the eventual rout of the ibex by a native who walked into its hiding place. This time I could see the final routing of the beast; the "Fuzzy" was only a short stone's throw from the ibex before the animal admitted defeat by running away.

The "billy" successfully avoided me, whom he had doubtless located early in the game, but tried to cross from one ridge to another and dropped down into the ravine between the two. This brought him past the post where Mr. Taylor waited.

In less time than it takes to tell, the ibex crossed the *khor* and appeared at the foot of the long climb on the other side. As the animal came up on a great rock and stood poised for an instant, the ravine roared from the shock of Taylor's rifle and a white spurt of rock dust puffed at the feet of the ibex. This did not alarm him any more than the rolling rock had done, and he began to climb deliberately for the sky. An ibex is not a large mark and at moderate ranges is missed surprisingly often. Puffs of dust marked the path of the ibex until, just as it was about to pass over the first low ridge and into safety, a bullet from Taylor's rifle found its mark and the hunt was over.

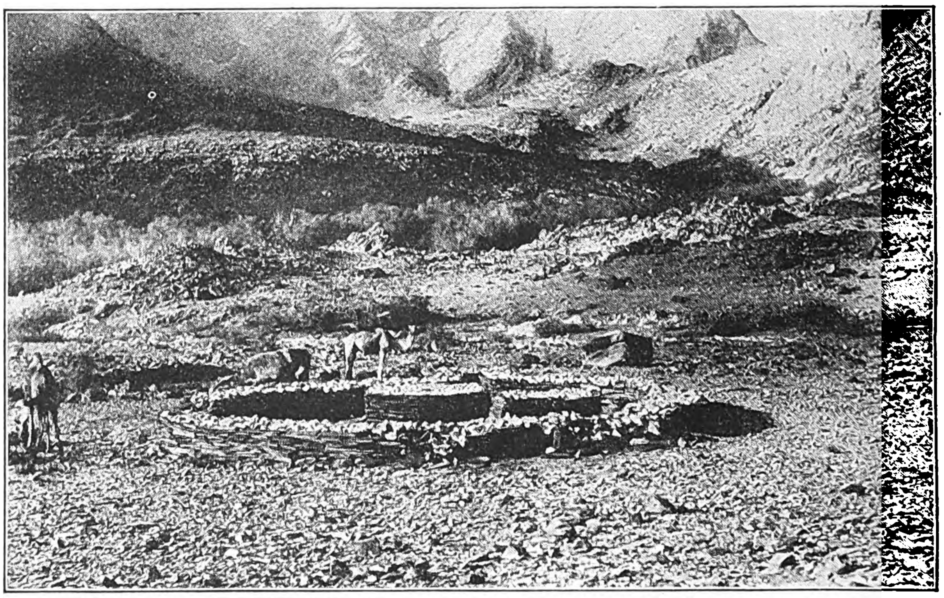
The ibex pitched clear of the rock where it stood and, striking only two or three times, fell almost sheer for a hundred yards. Strange to say, this fall did not hurt the beautiful sweeping horns, although it did rub some hair off the body. The horns measured 21½ inches, and although not as large as those of males killed later, gave us the greatest thrill of the trip because they were the first.

THE fortune of the chase favored Mr. Taylor, and to his rifle fell the next ibex secured, the largest head we took, measuring 38 inches along the horns. This "billy" was secured as the culminating event of a very long drive. Before daybreak we had departed from camp at Adelaueb and taken up separate stands on the Jebel Shalalta. The drive sent ibex part way along the rugged shoulders of the peak, but the animals turned back too soon and broke through the beaters before they could close up their widely extended line.

The entire morning was spent in the effort to get the band, which contained two good males, back on the Jebel Shalalta, but finally word was hallooed from the west that, as far as our stations were concerned, the hunt was finished. The ibex were headed for the Khor Mashail; if they attempted to cross that, we might get a shot later. We returned to camp and had lunch, while at intervals faint shouts in the distance told us that the "Fuzzies" were sticking like hounds to the scent and were still in touch with the ibex. Early in the afternoon the shouting took up the sustained reiteration of the short word the natives all used when the action became thick, and our guides hustled us out of the shade (thermometer over 100 degrees there) and down the Khor Mashail. Soon we separated and climbed up to posts which commanded the two ravines where the ibex were coming.

THE sun was pitiless and there was no shade. Slowly I fried on a big slab of rock and hoped that something would happen soon so that we could get back to the tent and shelter from the sun. The drive pelted into the ravines and then I could tell that the commotion was all passing down the one where Mr. Taylor was posted. Three or four ibex, females, appeared against the sky on a little peak that limited my northern horizon. They were slipping away from the beaters and waited just behind the peak, looking back the way they had come. A burst of firing in the next cañon roused the echoes; then comparative quiet reigned. The shouting ceased, and the ibex in my vision returned to the rocky slopes whence the drive had routed them. Mr. Taylor had secured a good "billy" and, incidentally, filled his license allotment.

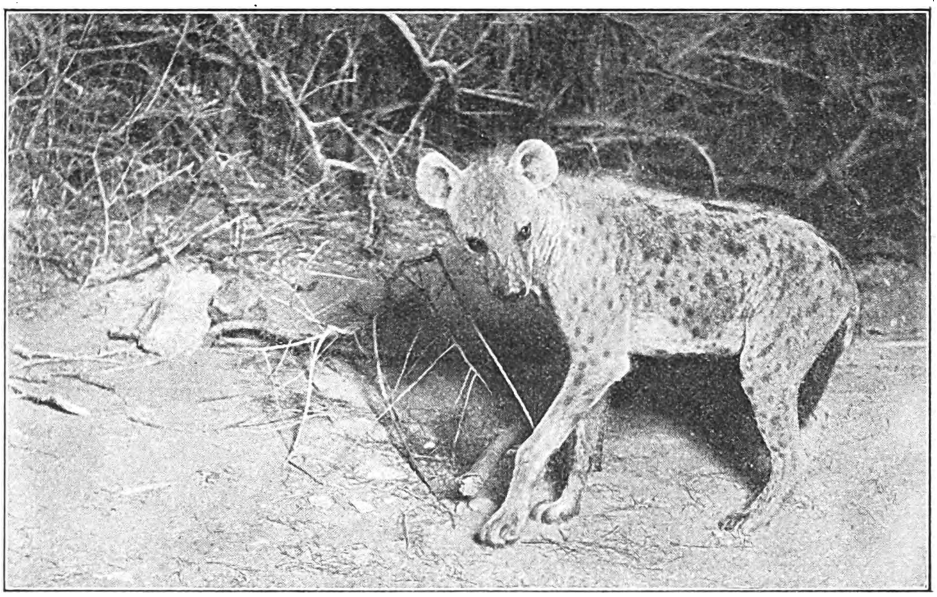
Male ibex with good horns seemed to be so scarce about the Khor Mashail that we moved camp over to the Khor Sharag to permit me a better selection for the remaining ibex I was allowed on my license. Early next morning I climbed the steep *jebels* above camp



NATIVE CEMETERY IN SUDAN

This illustration also serves to show the reader the character of the country in Sudan. Note the level plain, the scrubby vegetation, and the bare hills rising in the background and found a station which gave me a broad outlook over a wide expanse of rough and broken country. The "Fuzzies" scattered to the four quarters of the compass and Mohammed Ali and I settled back to wait for the drive. The first rays of the sun were welcome, for the wind was cool up there and I was content to bask a while in their warmth and to enjoy the early morning.

The rocks were beginning to take on heat, when movement along a distant skyline caught my eye. The binoculars disclosed a fine male ibex. This "billy" was taking no chances and remained high—a characteristic ibex trait—to seek the highest spot on the horizon and play hide-and-seek about it. He shortly dropped out of sight and another long wait followed.



A SPOTTED HYENA

By means of a cleverly designed setup of camera and flashlight apparatus, this excellent action photograph of a spotted hyena was secured during one of the cool Sudan nights

OUT of the northern sky, right where I had seen the ibex and where I knew my beaters were focusing their attention, a band of domestic goats dropped over a ridge and began to work down toward the wells in the *khor* below. A "Fuzzy" shepherd drove the flock and marshalled them in good order by shouts and grunts. He and his goats were silhouetted on a crest half a mile away but I could hear the click of each hoof against the rocks and the peculiar goat-like snort that the "Fuzzy" made from time to time. These natives have the faculty of emitting a resounding snort which is unlike any human vocal effort I have ever heard, and apparently it means something in the goat vernacular, for the beasts follow a snorting "Fuzzy" better than they would be driven by a shepherd dog.

In spite of this disturbance, the drive came to a successful conclusion. In due course of time, three ibex, all "billies," popped up against the horizon—what a picture a male ibex makes with his superb horns clear-cut against the sky—and ran down in the very tracks made by the domestic goats. The ibex circled and were headed by shouting beaters. The ring of excited "Fuzzies" drew tighter and tighter as the natives hurried up to the rallying call. A chant of "Ao, ao, ao" and "Ho, ho, ho, ho," punctuated by the crashing din of falling rock, brought us all to a fine pitch of excitement.

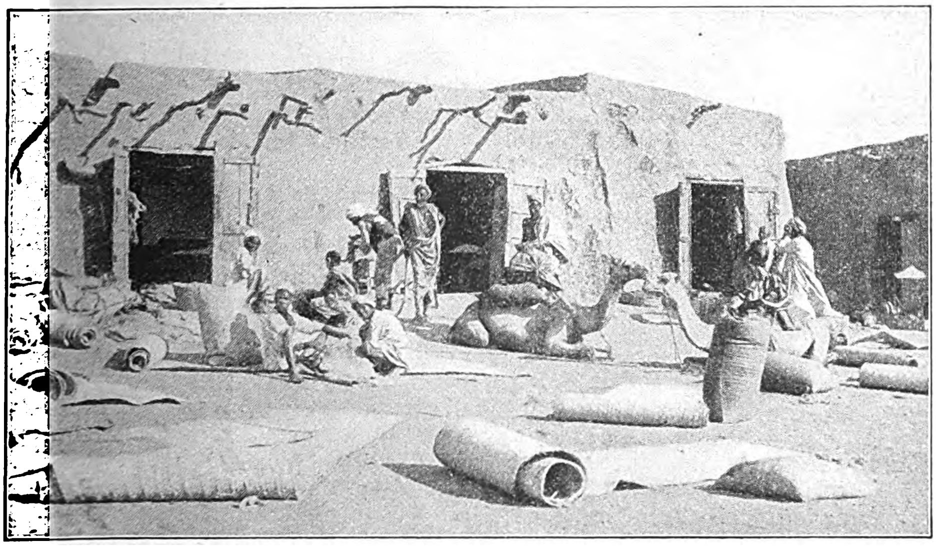
IT was apparent that the beaters had the ibex about where they wanted them, but were having difficulty, as usual, in the final push to send the animals down our side. Ali and I peered around our little peak first on one side, then on the other, but we could see nothing. When we could stand the suspense no longer, the old guide indicated to me that we had best climb to the next peak, a few yards higher up, and look into the basin which it masked from us.

We slipped out from our concealment and hurried up to the next spur. A few minutes of peek-a-boo about the rocks, and Ali grasped my arm excitedly to draw me still farther out from shelter. Leaning out over the crag, I found myself eye to eye with a bearded patriarch of the flock, a scant one hundred yards away. The ibex had been slinking off among the rocks and making such good use of the terrain that they almost escaped.

YOUNG IBEX

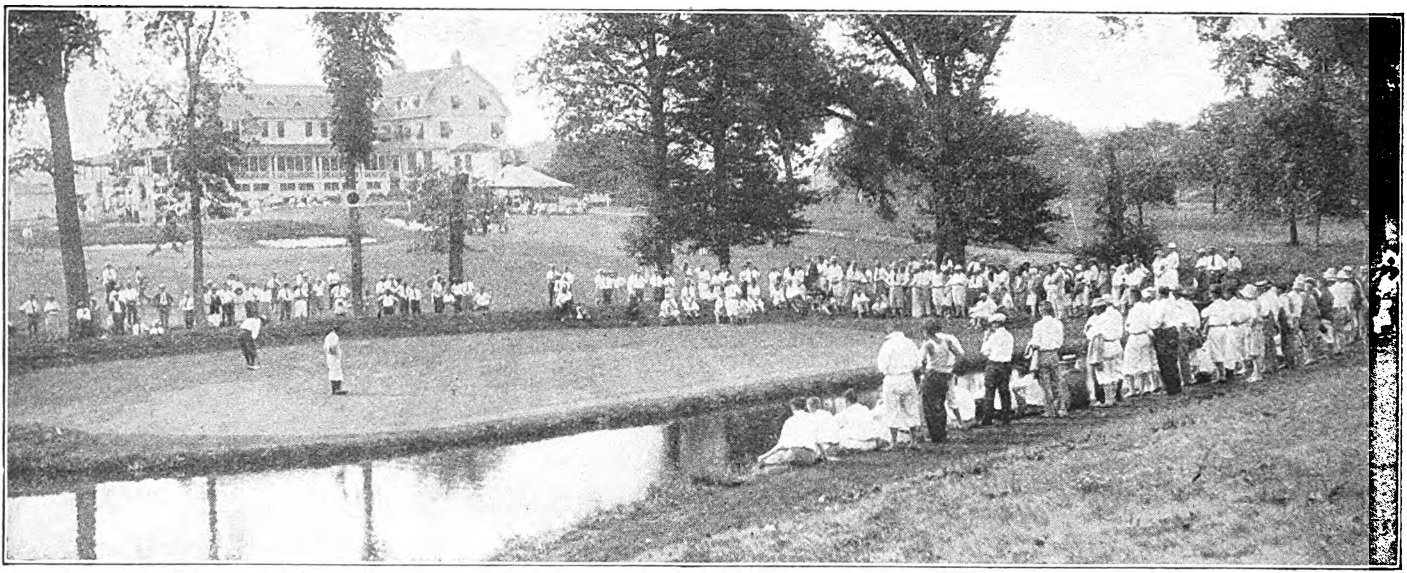
This tiny animal was captured and led around on a leash by one of the natives

The "billy" fell in his tracks, lodging in the rocks, which kept him from a long fall. At the shot, another splendid male ibex leaped into view, calmly took in the situation, and bounded down the hill. He was followed by a third male, equally large. I had my needed specimen and did not molest the others, but watched with admiring eyes that swift, sure flight over a slope so steep and precipitous that a man could descend it only by the use of hands, feet, and an abundance of time. To my mind, the only mountaineers that surpass the ibex are the birds.



MERCHANTS AT TOKAR

Tokar is the center of a rich cotton district, and is the point from which the author and his party set out with their caravan of camels for the habitat of the elusive ibex



TOMMY ARMOUR, THE "FLYING SCOTCHMAN," IN ACTION AT SHACKAMAXON, WESTFIELD, NEW JERSEY

Picturing Skill in Golf

A Newly Devised System of Charts Enables Golf Enthusiasts to Follow Intelligently Championship Matches

By CHAS. B. BREWER

WHEN "Sandwich, England" formed the heading of the various cables giving the news of performances at Saint George's links from May 8th to May 15th, 1928, the golfing fraternity in America watched them with the same eagerness with which they watched the 1927 cables from Saint Andrew's links in Scotland.

Walter Hagen soon formed the center of attraction, just as did, the year before, Robert T. Jones whom Americans love to refer to as "Bobbie" Jones. Jones, busy with his law practice in Atlanta, did not play in 1928.

Hagen kept playing irresistible golf, if such term may be used in connection with the steadiness with which he would climb over each of the others whose stars would seem to be in the ascendency. The brilliant play of "Wild Bill" Melhorn on May 9th, which would have won the title if continued, was overcome by the steadiness and persistency of Hagen. In the same manner Hagen outdistanced the spectacular playing of Jose Jurado, the little Brazilian player, and temporary hero, whose wonderful score of 69 on May 8th formed the best single score made during the matches on this par 72 course. Jurado also made 71 but his fall to 80 took him out of the running. Hagen's steadiness won.

THOUSANDS and thousands of golf "bugs" devoured the exciting news as the cables brought it over.

Hagen's own story was cabled on the very day he won the title. His difficulty with the hole known as "Suez" (Number 4) and his reference to another hole: "this hole has always been kind to me," and what he had to tell of this play and that was eagerly read by devotees of the game.

Much of the newspaper space given to golf plays on any certain course is wasted by a failure to state "par" for the holes played. With it, the description is pleasantly followed. Without it, the story is a study or oftentimes entirely lost.

With a "picture" which shows, first: the requirements; second: how nearly those requirements are met by actual performance; and third: an actual comparison of the playing of different players meeting the same requirements, any game may be readily vizualized at a glance if but a few moments are taken once to learn how to read such a "picture-chart."

EXAMINE Hagen's picture-chart. Hagen had difficulty with hole Number 1 on three of his four rounds. The chart shows that five strokes were required for this par 4 hole on all three occasions. Exactly the same thing happened to three of the four players shown on the combined chart (St. George's links) as may be seen by running the eye up the first column, which marks the first hole. Gene Sarazen made the hole in par. Melhorn, Hagen, and Armour failed.

On the other hand, it may be seen by glancing up the 11th column on Hagen's card, that Hagen made hole Number 11, also a par 4 hole, twice at par and once less than par; whereas, both Melhorn and Armour required five strokes for what Hagen did in three in his first round but likewise required five strokes in the third round.

The ten "birdies" which, with the steadiness of his play, gave the 1928 British golf title to Walter Hagen, are readily distinguishable by the frequent upward rise shown on his card. Two are shown in his first round; the first for Number 5 hole and the other for hole Number 11. Three "birdies" follow in both the second and third rounds. Two in succession are shown in both these rounds—the fifteenth and sixteenth holes of the second round and the sixth and seventh of the third. The two added to the list when the fourth round was played, gave him his par 72 for the round.

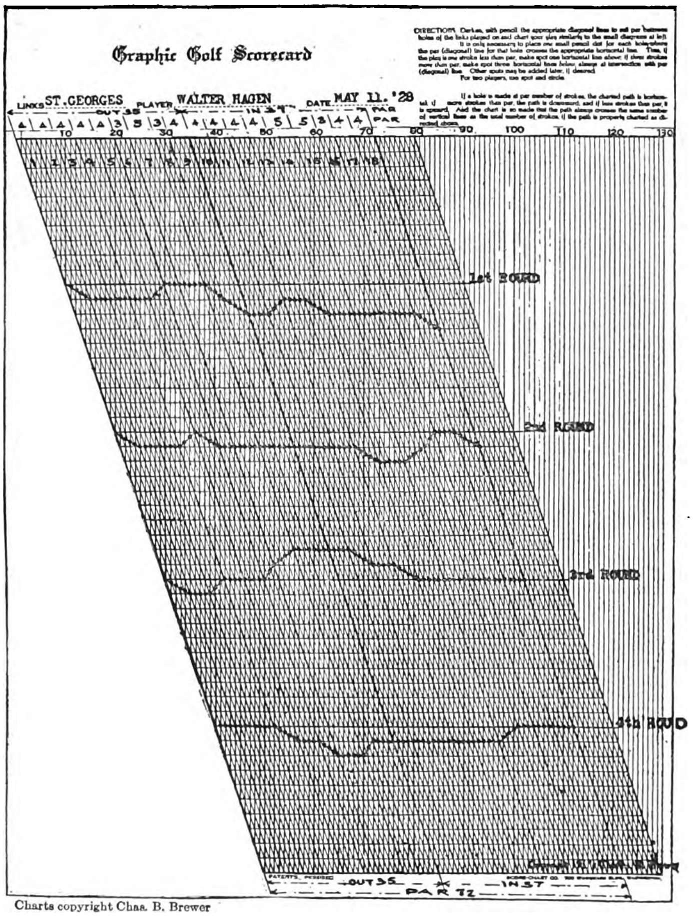
THE crowds which followed Bobbie Jones around Saint Andrew's course in Scotland in 1927 were soon rewarded. When he reached the fifth hole on his first round he played that par 5 hole in 3 strokes. The sharp incline shown on the chart at this point plainly marks the "eagle." This was immediately followed by a "birdie," then by a par play, to which were added two "birdies" in succession. Thus 15 strokes for what par asked 20 are shown on Jones' chart by the 15 dots on that many vertical lines of the fifth to the ninth holes, inclusive.

From the "picture" of this part of

the play, as shown in the illustrations, is readily distinguishable the most brilliant part of the excellency of the golf which has made our "Bobbie" Jones the admiration of two continents. He made this par 73 at 68 as against his notable playing of par 72 at 67 in his final round the following month—August 27, 1927—on the Minikahda links when he won the American Amateur Golf Crown. His total score, however, at Saint Andrew's, Scotland, was 285 for the par requirement of 292. How phenomenal was this playing is well illustrated by a comparison with the excellent playing shown by Hagen's chart which records a total score of 292 for a par requirement of 288.

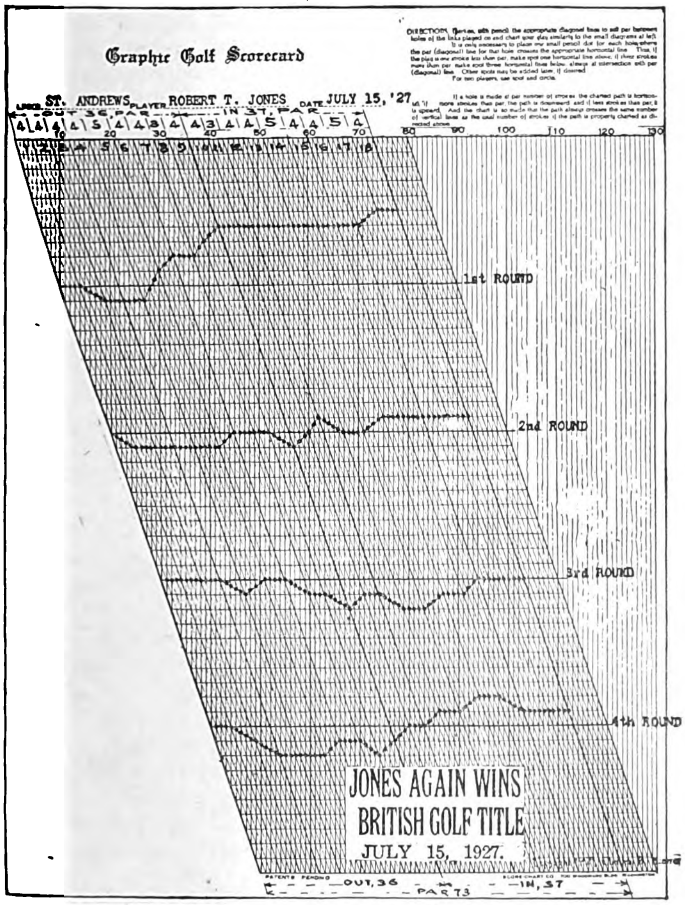
A moment's glance at the charts will show them to be so simple that few will escape their meaning if the text has been read thus far. For the benefit of any who may not have so read, it may be added that the charting of a play may be started on any horizontal lines which are crossed by a vertical line marked with a "10," "20," "30," or "40," in order to facilitate the count provided at top. The 10, 20, 30, or 40 is, of course, subtracted from the final figures.

For a play one *less* than par, the line extends to the point where one line *above* crosses the next "par" diagonal line; if two less, to the point where the *second* line above crosses the next "par" line. Likewise, if the play is *more* than par, the line extends downward and meets the next "par" diagonal line at a point where it is crossed by the *first* horizontal line *below*, if one more stroke than par is required. If two more strokes than par are required the line extends to the *second* horizontal line below. In his playing of the 13th hole, as shown on the chart dated May 9, Tom Armour illustrates a play where three strokes more than par were required, and the line extended *three* lines *below*. He recovered, however, on the next hole, playing that in one above par, and the next two in par. Two holes in one below par followed.



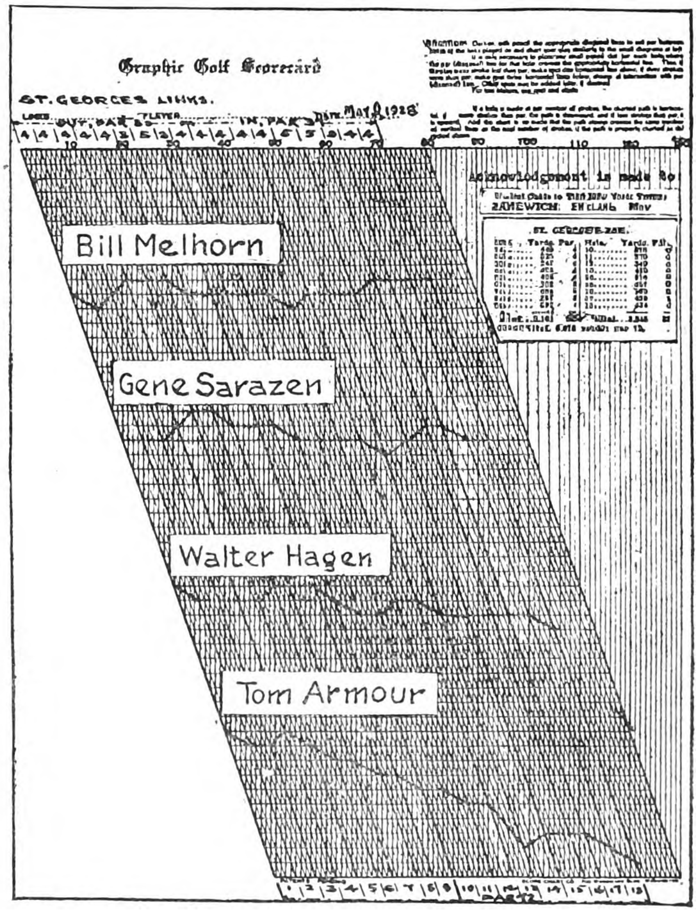
Charts copyright Chas. B. Brewer

HAGEN PLAYS ST. GEORGE'S
After learning to decipher these charts, the reader will be able to see at a glance just how each hole of the four rounds was played



JONES AGAIN WINS BRITISH GOLF TITLE
JULY 15, 1927.

JONES AT ST. ANDREW'S
In the first round, the "eagle" on the fifth hole is plainly shown by the sharp upward bend. This was followed by a "birdie"



FOUR CHARTS IN ONE
By placing the graphs of four players on one card, it is possible to contrast the play hole-by-hole, and to visualize the entire round

The Hunt for the Hub of the Universe

New Research Reveals the Long Sought Hiding Place of the Central Nucleus of the Galaxy, Confirming the Belief that We Live in a Spiral Nebula

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory, Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THE autumn meetings of the National Academy of Sciences are held each year in a different place. The one which is just over at Schenectady will be remembered by those who attended it for the hospitality of an old college and a modern industrial laboratory, and also for a number of important scientific communications. Among these the most noteworthy were those dealing with astronomy.

One of the dearest hopes of the astronomer has always been to "fling his plummet down the broad deep universe" and find bottom at last. That there was a bottom to find we have known since Herschel from his counts of the numbers of stars visible within the field of his great telescope showed that far down the Milky Way the fainter stars were relatively much less numerous than in it. This conclusion has stood the tests of a century of criticism—we still accept his deduction that the "universe" of stars which constitutes our Galaxy is a vast flattened assemblage, thinning out at a relatively small distance in a direction of the galactic pole but extending much farther in the plane of the Milky Way. Where is our system located within the starry universe? At the center, the edge, or somewhere between?

Yerkes Observatory

AN EXTRA-GALACTIC NEBULA

Our Galaxy, if viewed from without, would probably display this kind of a central condensation, and perhaps spiral arms

It has been known for a good while that we are nearly but not quite in the diametral plane which runs through the middle of the thickness of the Galaxy. This is sufficiently proved by the fact that the central line of the Milky Way itself divides the heavens almost into equal hemispheres. It is actually a degree or so nearer the southern galactic pole, whence it appears that the sun is slightly to the north of the exact median plane, but its distance from the latter is small, only a few hundred light years at most.

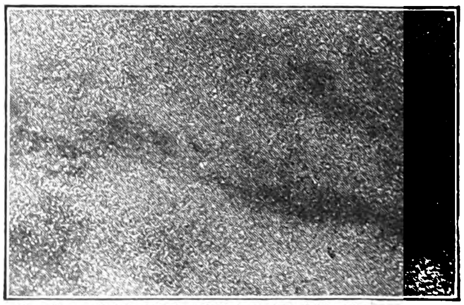
Whether our position as plotted on the galactic plane itself is near the center is hard to determine. Counts of the stars visible to the naked eye, or even those which can be seen in the small telescope, show about the same numbers for equal areas of the sky all around the Milky Way, and for this reason it was long supposed that we were near the center of things. But we now know that the soundings on our chart all came out the same because they should all have been recorded "no bottom." The distance to the confines of the Galaxy in its own plane, even when these are nearest, exceeds that at which even the brightest stars are individually visible in a small telescope. We must extend our study to the fainter telescopic stars if we are to hope for success.

THE first real idea how far we were out of center came a dozen years or so ago, when Shapley, then at Mount Wilson, applied a new and far more powerful method of determining stellar distances—the photometric. There are many kinds of stars which can be picked out by physical properties—variability, peculiarity of spectrum and the like, and the stars of many of these classes are of very great luminosity. The story has often been rehearsed how the true brightness of the Cepheid variables was found to depend upon the period, ranging from 100 times that of the sun for a period of a few hours to that of 10,000 suns for a period of a couple of months; and how, once this had been determined, distances 100 times greater than any which had been measured could be worked out.

In particular, the globular star clusters found themselves to form a gigantic assemblage or cluster bisected by the plane of the Galaxy, more than 200,000 light years in diameter and with its center about 50,000 light years from the sun, in the direction of the constellation Sagittarius (more precisely in 327 degrees galactic longitude and 0 degrees galactic latitude).

The Milky Way in this region of the heavens is far brighter than in the opposite quarter; but it is cut up by great dark lanes and patches. No one doubts longer that these dark regions are obscured by immense dark nebulae—clouds of dust or "fog" in interstellar space would appear much broader and still brighter. The obscuring clouds, or some of them at least, are associated with visible stars in such a way that we can estimate their distances, which are found to be only a few hundred light years. Could we get behind these clouds and see the Milky Way unobstructed it would appear much brighter and more extensive. But it would be almost as far away as ever.

THE photometric method of measurement, which has been so effective with the globular clusters and even with the remote spiral nebulae, is eminently adapted for an investigation of all parts of the Milky Way itself. An extensive and very well planned campaign for such a study has been initiated at Harvard by Dr. Shapley, and the first results reported at Schenectady make very remarkable news. Thousands of plates have already been taken and thousands more will be, for the completion of the program will take 10 or 15 years more. Only a few of the 240 different fields, which among them cover the whole extended Galaxy, have yet been studied, but these few have told a great deal.



From Barnard's Atlas of Selected Regions of the Milky Way

DARK CLOUDS OF DUST

"The Milky Way in this region of the heavens is cut up by great dark lanes and patches." One of the great dark lanes

One region in particular, about eight degrees square, on the borders of Scorpio and Ophiuchus, has been found to contain no less than 450 variable stars. Seventy-two of them were known before Miss Swope began a systematic study of the photographs a year ago. Almost 400 more have since been found. They are all faint (the brighter ones having already been picked up) and this means that they are a long way off. Seventy-eight of those stars are shown by two observations to be of the "cluster-variable" type with a restricted range of variation (about one magnitude) and short period ranging from seven to seventeen hours. Previous studies of these stars in other regions have shown that they are with remarkable uniformity about 100 times as bright as the sun. The distance of each star may therefore be calculated as soon as its type of variation and average apparent brightness have been found. Twenty percent of them lie at distances ranging from 21,000 to 30,000 light years. The rest are fainter and range from 35,000 to 55,000 light years, with a sharp concentration about the middle of this interval. These stars lie within a few degrees of the direction of the center of the system of globular stars and at substantially the same distance.

It appears, then, that there is actually an enormous mass of stars concentrated near this point which forms the central nucleus of our Galaxy. Observations in neighboring regions of the sky will be required to define fully the outline and limits of this vast star cloud. But the existing material indicates that, measured to its outer limits, it is some 55,000 light years thick and probably even larger in diameter. The exact center is hidden behind one of the dark obscuring nebulae perhaps only a hundredth part as far away. But the starry mass behind shines around the cloud on all sides and appears here and there through gaps in it, so that we may hope in no long time to have a reliable idea of its extent.

From Barnard's Atlas

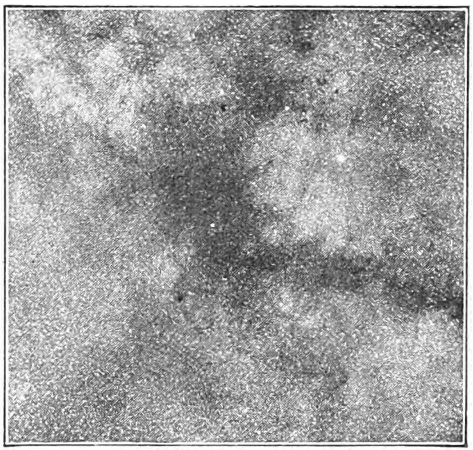
A GREAT STAR CLOUD

A rich region, part of the nucleus of the Galaxy, across the galactic equator in Sagittarius. Negative made at Mount Wilson

Viewed from a far distant point millions of light years away, at an angle to its own plane, the Galaxy would thus show a prominent central condensation—as most of the extra-galactic nebulae do. Whether the stars outside this form subsidiary condensations, and whether these are arranged in spiral arms, no one yet knows, but a decade of work may enlighten us.

This new evidence of the enormous extent of our stellar system indicates that it is many times larger than any of the known nebulae. The great nebula of Andromeda, the largest of these, is about 40,000 light years in diameter, so that there seems to be abundant justification for Shapley's remark, "If these are island universes, the Galaxy is a continent."

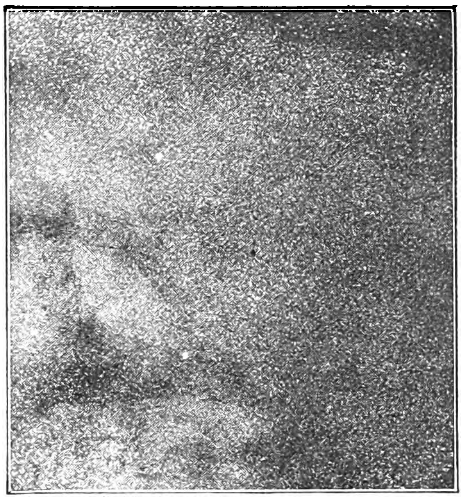
One difficulty may arise in the reader's mind. How can we be sure that there is not some thin, uniform haze in space between us and the distant stars which makes them look fainter than they otherwise would, and exaggerates their calculated distances? This is a fair question, but the answer is ready. The photographs show a number of small, faint nebulae of the extra-galactic type among the stars of the great cloud. There is practically no doubt that these are island universes seen through the open spaces between the stars, and probably many hundreds of times farther away even than the latter. If these excessively remote objects are visible, space must be clear of haze in their direction.



From Barnard's Atlas, courtesy Carnegie Institution of Washington

MORE OBSCURING MATTER

In Ophiuchus, between plates above and below. All three plates are eight degrees square. The regions are visible in summer



From Barnard's Atlas, by permission

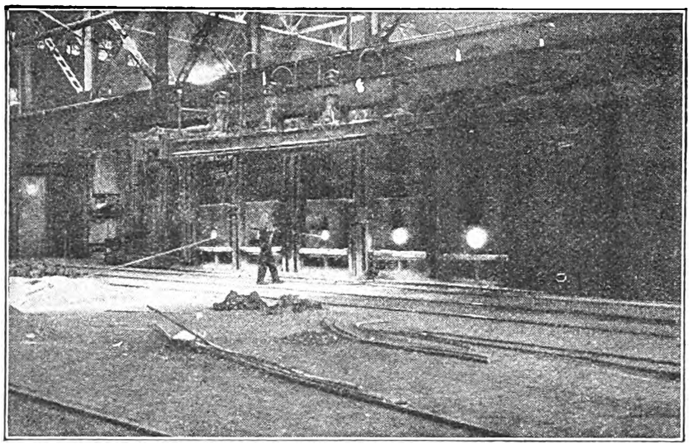
PART OF THE NUCLEUS

The region of star clouds the author refers to, in which the 450 variables were studied on the Harvard Observatory plates

Very good evidence in further support of this conclusion was also reported by Dr. Shapley. Studies of the nebulae in the region of Coma Berenices and Virgo, in which they are very numerous, have revealed the existence of a great cluster of nebulae whose distance Shapley estimates at 11,000,000 light years. Two or three smaller clusters of fainter nebulae which appear not far off in the heavens must be much more remote; and besides these, and scattered all over the sky, are a multitude of nebulae fainter still, and forming a still more distant background. Measuring the apparent diameters and brightness of all these, Shapley and his colleagues find that, on the average, nebulae which send us 1 percent as much light as the brighter group show 10 percent of their apparent diameter. This is just what we should expect if inter-nebular space was perfectly transparent and the nebulae themselves averaged up to the same size in different regions. If space were hazy, the distant nebulae would look fainter but no smaller, and the relation between apparent size and apparent brightness would be different from that which is observed.

This important observation confirms a conclusion previously reached by Hubble, from his counts of the numbers of nebulae of different apparent magnitudes; namely, that there is no perceptible weakening of light in its passage through space, even out as far as the remoter nebulae. Nebulae have already been observed which are in all probability more than 100,000,000 light years distant. With the great telescope which is soon to be constructed this limit may be pushed as far as a thousand million light years. So far as study has gone, there appear to be vast numbers of nebulae at the very limits of visibility and there is no reason to believe that an end can be reached by any means now in prospect. One recalls again the words of Rosetti's sonnet, picturing one gazing toward the far horizon.

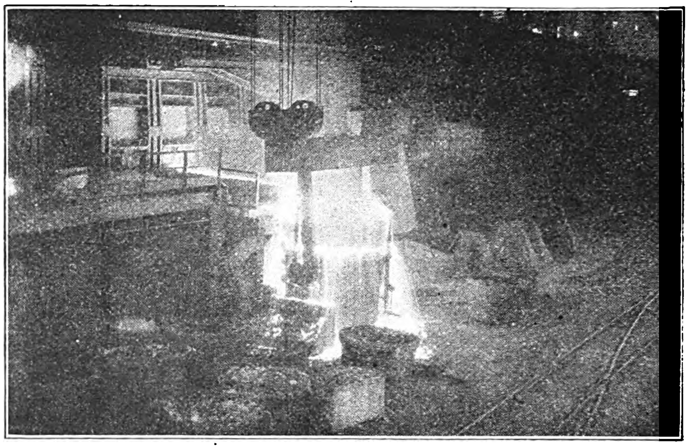
"Miles and miles distant though that
grey line be,
"And though thy soul sail leagues and
leagues beyond;
"Yet leagues beyond those leagues
there is more sea."



All photos courtesy American Rolling Mills Company

WORKING A HEAT

Constant care is necessary to secure the required content. The operator watches his charge as a housewife watches her cooking

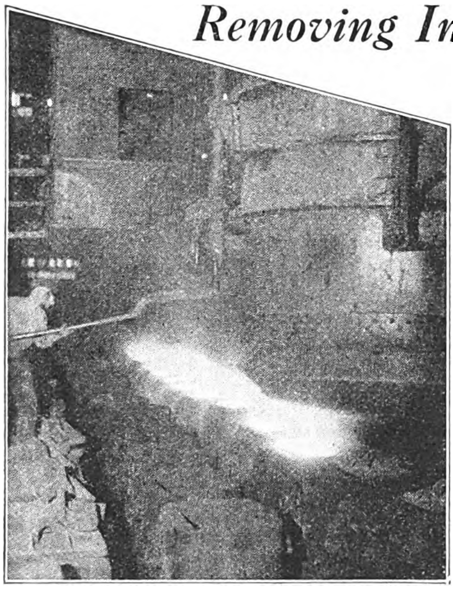


MOLTEN SLAG

The slag floating on the top of the mass of molten metal overflows the waiting ladle when the open hearth furnace is tapped

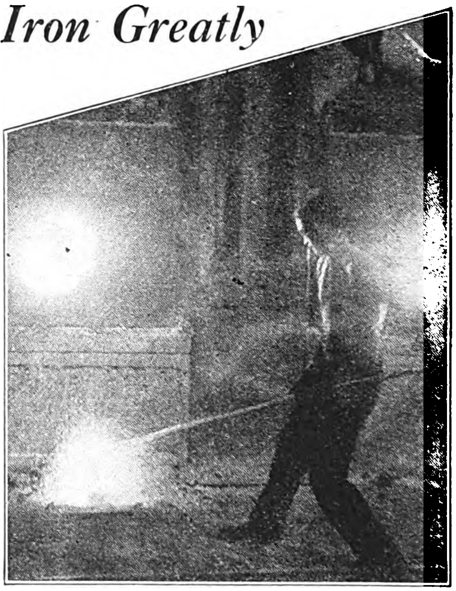
In The Birthplace of Pure Iron

Removing Impurities From Smelted Iron Greatly Increases Its Usefulness



TAPPING

Here is the apparatus which controls the flow of the molten iron from the ladle



TESTING

A test spoonful of molten iron is taken from the seething bath in the furnace

THE romance of iron, a metal more important than silver or gold, has been interwoven with the development of civilization since the dawn of history. Wrought iron was first produced direct from the ore. The reduction of ore to malleable metal takes place at low temperatures, so that it was possible for the early workers to make it with their primitive equipment. The advent of the Bessemer process revolutionized the practice of iron making. A new material, steel, that in the earlier stages was not differentiated from iron, had come into being. The open hearth furnace had been perfected; and for the first time in history the different phases of the production of such finished products as sheets were gathered together at one plant.

Prior to 1905, the mid-western farmers complained to the United States Department of Agriculture that their fences were rusting out rapidly. The department investigated and discovered that corrosion was in direct proportion to impurity content of the iron. One mid-western iron manufacturer, who recognized the importance of scientific investigation, turned his entire research resources upon the problem of developing a pure iron that would resist corrosion. In 1908, the first time in metallurgical history, and contrary to the established theory as written down in the authoritative metallurgical text books of the day, a commercially pure iron was made in a modern open hearth furnace.

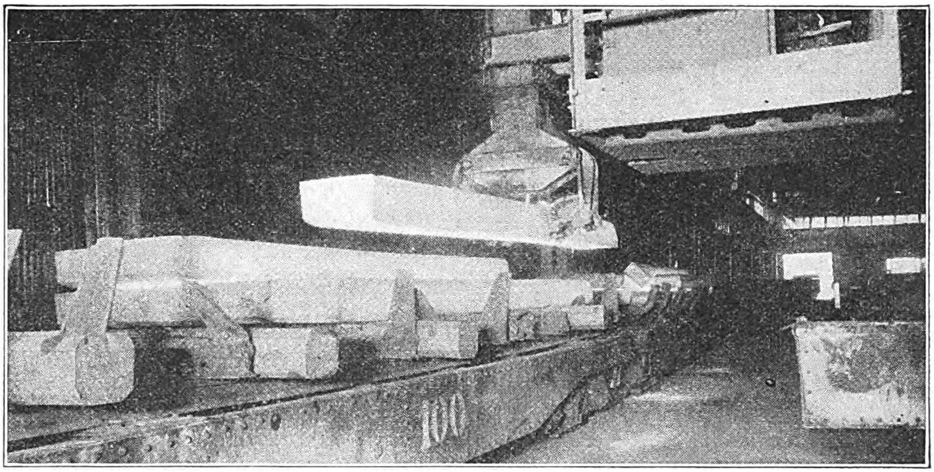
THE manufacture of this pure iron is indeed a stirring sight. The whole process from start to finish is carried out on a magnificent scale. The huge blast furnace, often a hundred feet high, roars away at its task of smelting iron ore night and day, week in and week out. Every four hours it discharges a fiery stream of molten iron which runs into a ladle that looks like a Zeppelin on wheels. (See page 257, September issue, SCIENTIFIC AMERICAN.) The metal is extremely high in carbon content, and if cast, is too brittle to be worked; so from the blast furnace it journeys several miles in this giant "thermos-bottle" to the open hearth furnaces where the work of refinement goes on.

The open hearth furnace is a huge covered hearth about 75 feet long, shaped like an oval saucer. Upon this play the incandescent flames from the gas producers. With a quantity of melting-stock, the molten pig iron is plunged into the open hearth where the material seethes for hours. Here most of the detrimental, rust-promoting impurities in the metal are burned out.

Periodically, the furnace operator takes a test sample of the molten metal which is sent to the laboratory for careful analysis. Occasionally, materials are added to aid the purification, until finally, the analysis reaches the set, and rigidly-adhered-to, standard. Then there is much bustle and hurry in the neighborhood of the furnace. The great, spidery crane approaches from out the shadows. Its long, tentacle-like hooks drop down and grasp the waiting ladle. At a signal from the furnace operator, the plug that dams the molten bath is knocked out, and, with a thundering roar, the molten iron crashes into the ladle, sending up showers of sparks.

For perhaps 15 or 20 minutes this blinding flow of light and heat continues until, with a wave of his hand, the operator signals the crane man to remove the molten iron, to be poured into the waiting ingot molds. At the proper moment the ladle pourer lifts a release lever on the side of the ladle, and the liquid iron pours into the top of the upright molds. When the molds are filled, a donkey engine attaches itself to the waiting string of mold-laden buggies and hauls them away into position under the stripper crane.

As soon as the metal is solidified, this crane extends its claws, grasps each mold, and lifts it from the gleaming ingot. Another crane swings these ingots up and throws them into the yawning maws of the nearby soaking-pits. Here the temperature is equalized throughout the ingot. The center is allowed to solidify, while the outside is held at rolling temperature. When this is accomplished, the overhead crane again plunges its two fingers into the blazing pit and snatches out a dripping ingot. Incandescent with pent-up heat, the ingot is placed on a roll-train which quickly conveys it on its way. The great blooming-mill rolls spread wide their crashing jaws to receive it. Back and forth the ingot passes, growing longer and thinner until it looks like a ribbon of light.



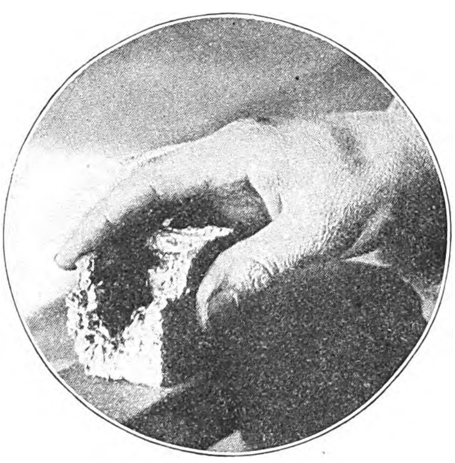
ELEVEN-THOUSAND POUND SLABS

This huge crane tosses these eleven-thousand pound slabs around like match sticks. Here you see them being loaded, red hot, on massive and specially constructed cars made of steel

HERE the ways of the old and the new methods part. In the old practice this "bloom," which was an ingot, passes on to the bar mill for further reduction. Presently, it is cut into lengths, just the width of the finished sheet to be rolled. These lengths are re-heated and passed by hand back and forth between rolls, until they assume the appearance of flat sheets ready for the manufacturer. They are then cleaned in an acid bath to remove surface dirt.

Next, the sheets are enclosed and sealed in heavy cast iron boxes, and pushed into furnaces to be annealed. Here the temperature is just high enough to remove all the strains in the metal, caused by rolling. They emerge from these furnaces a day or two later, soft and ductile, so that they can be formed, drawn or stamped. After the sheets are annealed they are again passed between rolls to be flattened.

Harking back to the parting of the ways—how different is the modern method from this old method of hand rolling. Instead of tedious "back-and-forth-between-the-rolls" practice that has been in vogue for over 40 years, the blooms are taken from the blooming mill and placed in a holding furnace. Presently, they are shoved from this furnace to land automatically on roll-trains that carry them away to a "universal mill." With a vicious hiss the red-hot slab of metal strikes the first water jet curtaining the rolls of this mill. The rolls spread wide their jaws to receive the bars. Almost more quickly than the eye can travel, the bar shoots through the universal mill and along the roll-train that seems to slope away indefinitely into the distance.

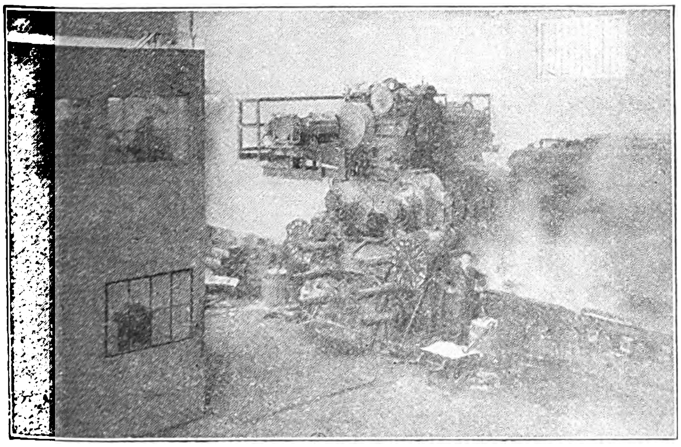


FRACTURE

Castings, broken in two, enable experienced operators to read the carbon content

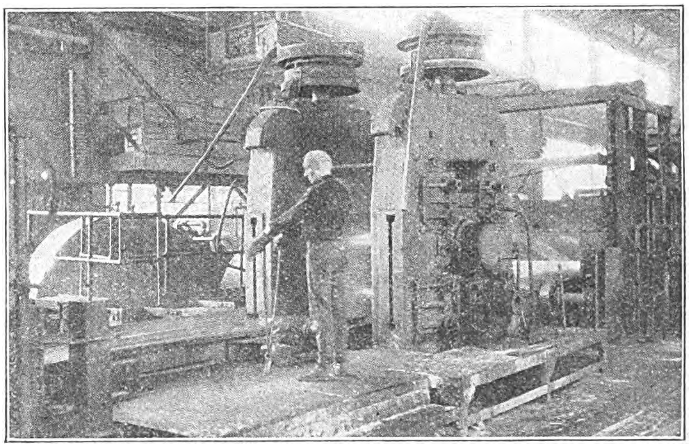
WHILE strips are nothing new in the industrial world, a continuous strip of metal 36 inches wide is just 16 inches wider than the maximum strip produced previously in this country. In these mills, four rolls high, a great reduction in thickness takes place. The short, fat bar that came from the holding furnace is now a long strip of sheet iron. It moves faster and faster as it passes between three more four-high mills. Leaving these, the long strip plunges into a slot in the wall of a long, low, box-like structure. Before you can run to the opposite end it is already streaming out.

This structure is a continuous pickling machine. Immediately after the strip emerges, it is washed and dried. This transpires in less than the time it takes to write about it. Then the



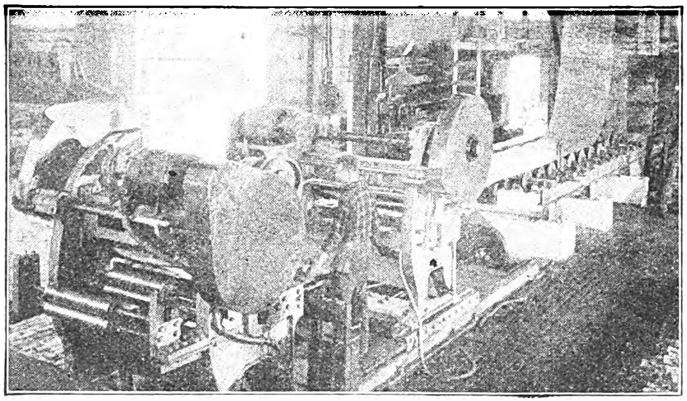
A HUGE MILL

This universal mill rolls the hot ingots into slabs for the continuous mill. The building at left houses the controlling apparatus



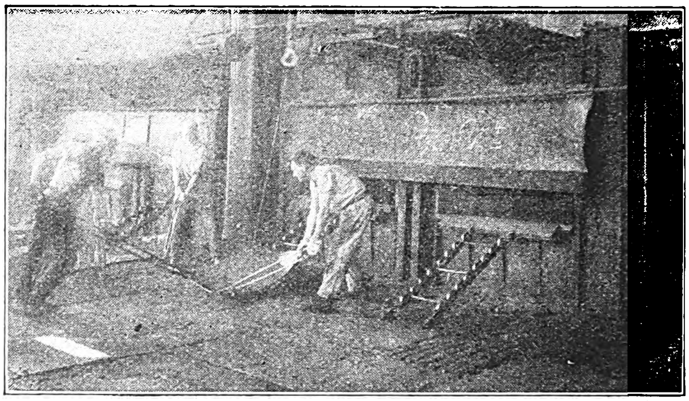
WATCHING THE RIBBON

Immobile he stands, watching the ribbon of cherry-red metal elongate as it dashes through the rolls on its continuous passage



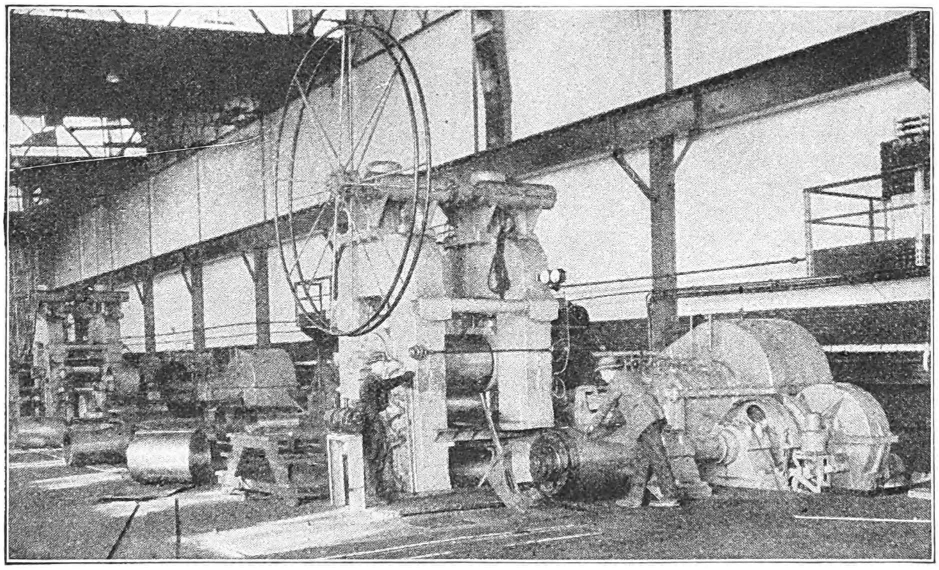
MIGHTY SHEARS

The continuous tandem shears make it possible for the sheets to be handled separately through the various finishing operations



REHEATING

Before being rolled further the sheets must be reheated to bring to a rolling temperature. The sheet is being put in the furnace



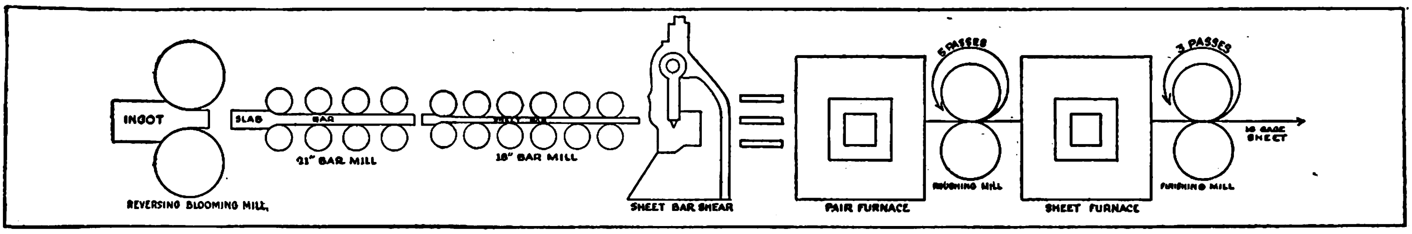
MAMMOTH FINISHING ROLLS

These great rolls serve to give the high finish which is so essential in modern automobile construction. The adjustments are capable of great refinement. Note the size of the rolls

strip plunges into a continuous annealing furnace, passes rapidly to the coiler and, almost before you can realize what is happening, the 60-foot length of sheet iron is coiled tightly, picked up by the crane, and carried to the storage rooms.

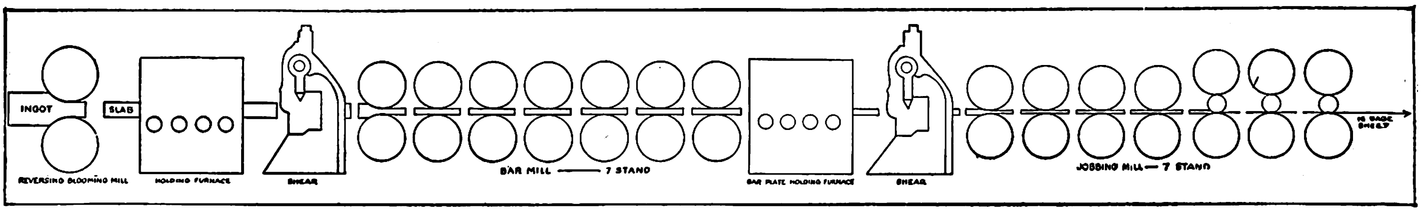
From the storage rooms the coils are drawn as they are needed, decoiled, and cut into desired lengths. These may need further rolling, depending upon the purpose for which they are used. If the sheets do need further treatment, it is done by the hand method as in the old practice. One of the marvels of the new process is the fact that this new strip sheet mill can turn out as much sheet metal as 40 of the old type mills, which operate more slowly, could produce in the same space of working time.

WHAT is to become of this vast output of sheet iron? If you will look around you, you will quickly see the answer. In every field of industry sheet iron plays an important part. Railroads absorb vast quantities of it for roofing and sides of their buildings and for culverts. Manufacturers of household products such as porcelain-enameled ice boxes, stoves, kitchen tables, and countless other products consume thousands of tons of sheet iron from which they fashion their products, because the ceramic enamel adheres best to pure iron. The oil industry draws endlessly upon pure sheet iron for pipe lines and tanks. The general building trades are tremendous users of pure iron for roofs, gutters, ventilating systems, et cetera. A list of users for pure iron would be an endless one, growing longer every day, and every product offers a new chapter in the romance of manufacturing.


INGOT
SLAB
BAR
SHEET BAR
REVERSING BLOOMING MILL
21" BAR MILL
18" BAR MILL
SHEET BAR SHEAR
5 PASSES
PAIR FURNACE
ROUGHING MILL
3 PASSES
SHEET FURNACE
FINISHING MILL
16 GAGE SHEET

MILLS OF THE OLD ORDER

This schematic diagram (courtesy *Iron Trade Review*) shows the sequence of operation through which an ingot passes in being reduced to a slab and finally to a 16-gage sheet on conventional hand mills. This process. as described in text, is slow and very costly


INGOT
SLAB
REVERSING BLOOMING MILL
HOLDING FURNACE
SHEAR
BAR MILL —— 7 STAND
BAR PLATE HOLDING FURNACE
SHEAR
JOBBING MILL — 7 STAND
16 GAGE SHEET

THE CONTINUOUS PROCESS

This schematic diagram, for which we are indebted to the *Iron Trade Review*, shows the stages through which an ingot passes in being rolled to a slab on a bloomer and finally to a 16-gage sheet on the continuous process installation at an Ashland, Kentucky, plant

The "Sinking" Tower of Pisa

By ALBERT G. INGALLS

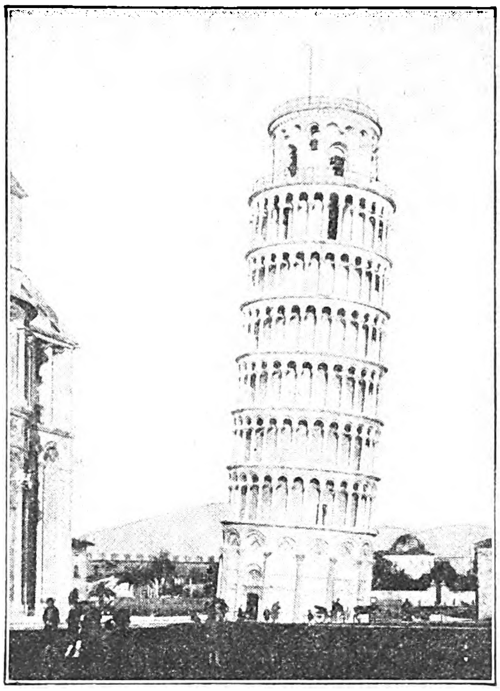
FOR centuries the famous Leaning Tower of Pisa has been sinking vertically into the soft river valley sediments on which it rests, at the average rate of a millimeter a year. That long-continued process is now about to be brought to an abrupt and permanent stop. If the present plans of the Italian government are carried out as vigorously as work has already been begun, the ancient tower, which has stood on a poor foundation since A. D. 1174, when its construction was started, will soon be equipped with a broad, secure footing. Yet the structure itself will not have been moved an inch in the process, either up or down or sidewise.

EMPHATICALLY the Leaning Tower is not to be straightened up. While a restoration to the intended vertical, doing away with its 14 feet of inclination in a total height of 178 feet, might make appeal to the severely practical minded, yet it would also do violence to the sentiments long connected with this historic structure. There are many other beautiful campaniles in the world but there is only one Leaning Tower of Pisa.

The plan which will be pursued, short of some unanticipated discovery which might conceivably alter it, is to inject cement in liquid form through pipes inserted under the Tower, by one of the well-known cementation processes which are now being employed in certain kinds of engineering work where direct access is difficult or impossible. This work will doubtless be performed by the firm which is at present carrying on preliminary experiments at the site of the Tower; the same firm, in fact, which is at present safeguarding St. Paul's Cathedral in London by cement injection, as previously described in the SCIENTIFIC AMERICAN.

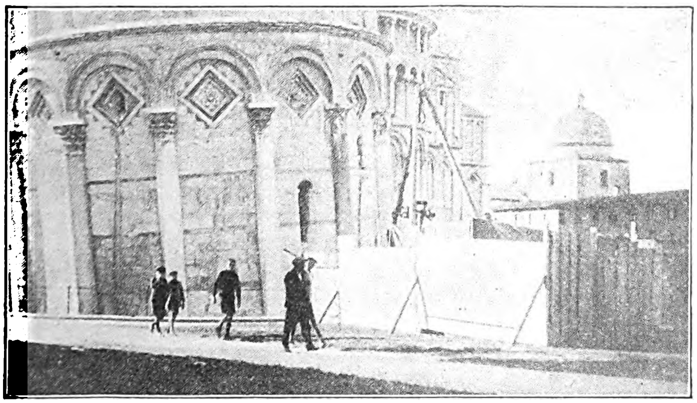
Late last autumn when the operations at Pisa were inspected, a most interesting large-scale test experiment was found to be in progress. Instead of proceeding directly with the injection of cement under the priceless Tower, an operation whose complete success would possibly be problematical, the *Commissione Ministeriale per la Torre di Pisa* of the Italian government has let to the François Cementation Company, Ltd., of Doncaster, England, the contract to carry out a series of preliminary experiments upon the soil at spots to be chosen as near the Tower as can be tested without involving direct risk to it. These experiments should provide valuable and exact data concerning the bearing resistance of the various strata of sand and clay in the neighborhood and to a considerable depth. These data will include the pressure at which the cement can be injected into the ground; the quantity of cement the ground will take; the increased bearing resistance obtained; the condition of the treated ground after varying intervals of time; unit factors of time and cost; information as to the best sequence of operations; depths of injection, and so on. The large scale experiment partly shown in one of the illustrations will be duplicated on a number of plots within a like radius from the Tower. Finally, and in the light of the experience gained by the experiments, the soil directly under the Tower itself will be tenderly and cautiously operated upon.

At the time mentioned, one small job was nevertheless taking place directly under the Tower. This, however, had nothing immediate to do with the repair of its foundations, but consisted, rather, in the careful extraction of sample cores of earth four inches in diameter and several fathoms in length. The sampling equipment shown within an enclosure in one of the illustrations, was set up successively on each of the four sectors immediately adjacent to the Tower and cores were taken in an inward slanting direction, thus providing samples from beneath it. These cores, it is of interest to note, do not agree closely in stratification with other cores made only 200 feet from the Tower. This is not surprising, as the various strata of sand and clay in the entire neighborhood represent river estuary deposits and such strata are apt to vary quite radically in nature within short distances. This emphasizes and confirms the need of making a whole series of test experiments as described, in order to insure success.



WHERE GALILEO TRIUMPHED

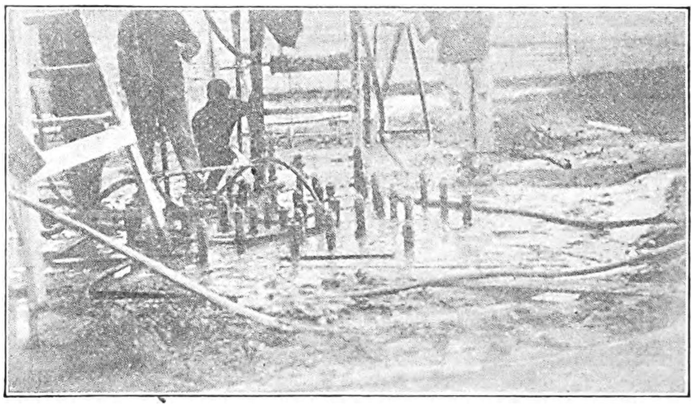
Here the famous experiment on the relative rate of descent of falling bodies took place



All photographs by the author

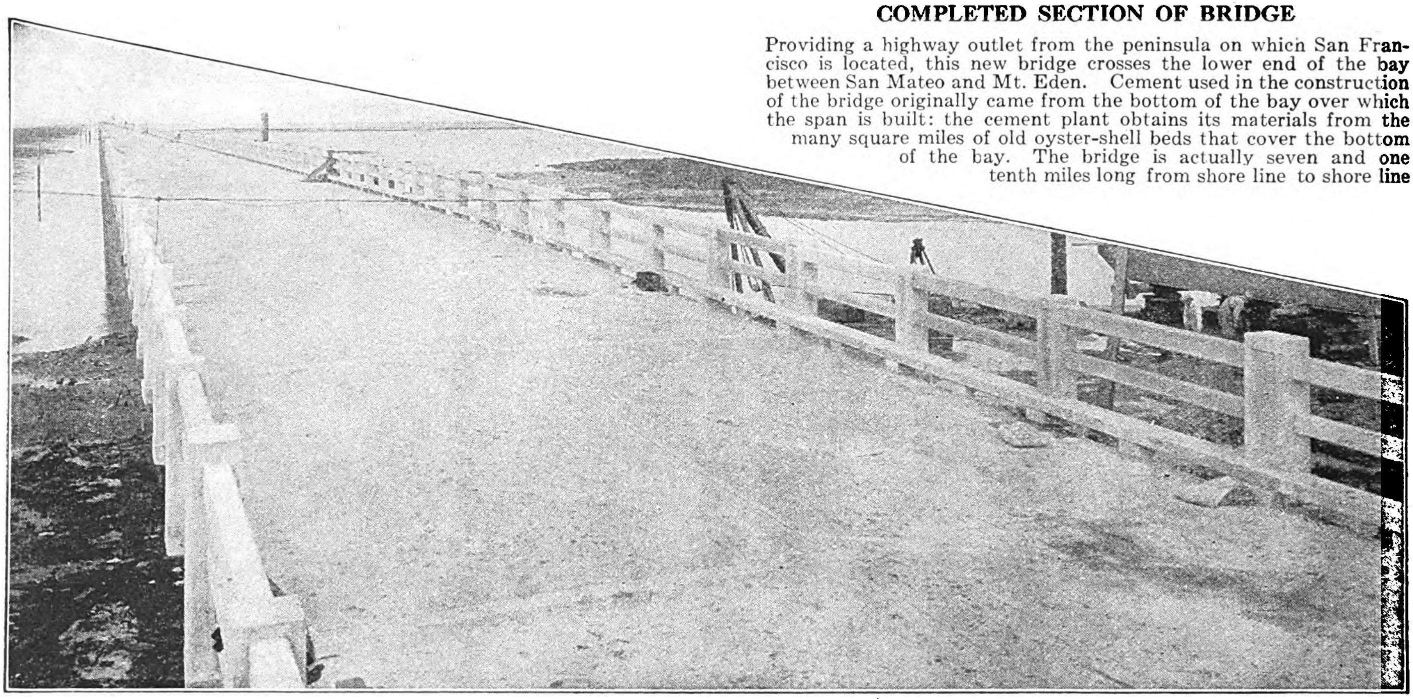
WHAT IS UNDER THE TOWER?

A core drilling machine projects above the temporary enclosure. Here samples of the sand and clay beneath the Tower were taken



PART OF A TEST EXPERIMENT

A hose line may be seen connected to one of the vertical pipes. Nearby were cement mixers and heavy pumps for injecting cement



COMPLETED SECTION OF BRIDGE

Providing a highway outlet from the peninsula on which San Francisco is located, this new bridge crosses the lower end of the bay between San Mateo and Mt. Eden. Cement used in the construction of the bridge originally came from the bottom of the bay over which the span is built: the cement plant obtains its materials from the many square miles of old oyster-shell beds that cover the bottom of the bay. The bridge is actually seven and one tenth miles long from shore line to shore line

A Pre-cast Seven Mile Bridge

Concrete Bridge Across the Bay Below San Francisco Is Made Up Almost Entirely of Pre-cast Units

By CHARLES W. GEIGER

EVER since the days when the padres trod their laborious way along *El Camino Real* around the southern end of the bay from San Francisco, in order to reach the missions to the east and north, the crossing of San Francisco Bay has presented a problem.

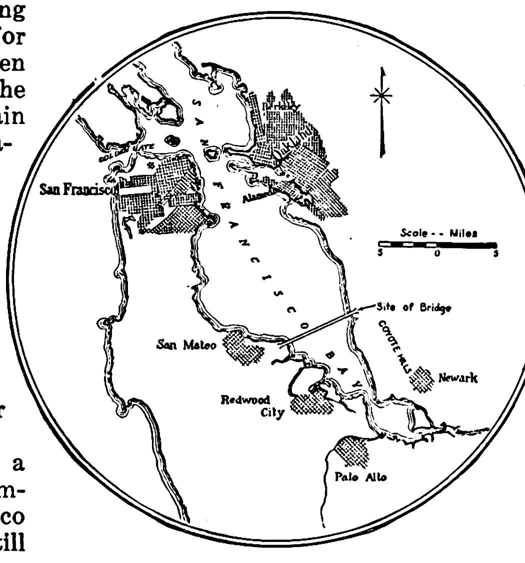
With every stage in the bay region's development that brought increased population and increased traffic congestion, that problem became more pressing. For a generation or more there has been agitation for bridging the bay, and innumerable projects for accomplishing that purpose have been discussed, promoted, and shelved. The advent of the automobile made certain that the demand for easy communication between San Francisco and the mainland would eventually force an answer.

IN spite of a great increase in ferry facilities during the past ten years, the congestion of motor traffic on San Francisco's few outlets, water-bound as the city is on its peninsula, has reached greater and greater degrees of density.

While the question of building a direct bridge to accommodate commuter traffic between San Francisco and Oakland remained—as it still does—without solution, the organizers of the San Francisco Bay Toll Bridge Company conceived the plan of a low-level bridge farther to the south, that would not only serve automobile traffic between the two sides of the bay, but would provide an easy avenue of communication to the city for the rapidly increasing freight and passenger traffic from the great central valleys of the state and from the east.

A location was sought that would combine the advantage of being close enough to San Francisco to relieve the traffic congestion, and that of economical construction by utilizing the shoal waters that stretch along both sides of the bay for many miles below the two chief population centers.

After extensive surveys comprehending all essential factors, such as motor travel over all routes tapping San Francisco, construction costs, and engineering features, the location was selected where the San Francisco Bay toll-bridge is now nearing completion.



THE NEW TRAFFIC ARTERY

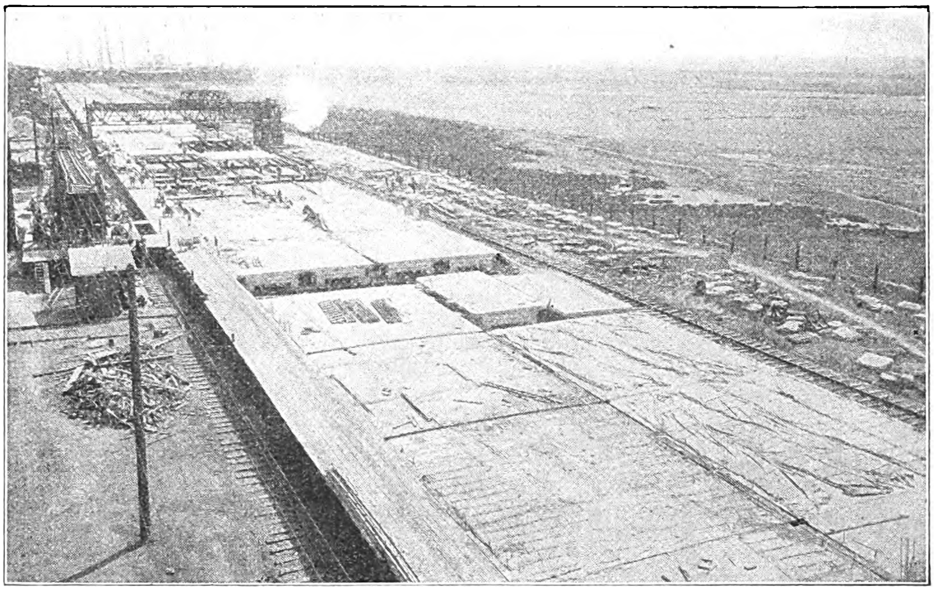
Location of the new bridge in relation to the city of San Francisco and other points

THIS site lies between what is known as Little Coyote Point, opposite the foot of Third Avenue in San Mateo, and Mt. Eden, on the Alameda site, near Hayward, where the Dublin Canyon road debouches through the mountains and brings the transcontinental Lincoln Highway virtually to sea level.

The San Francisco Bay toll-bridge is 7.1 miles from shore line to shore line, making it the longest highway bridge in the world. With the exception of the piers, pile caps, and fence posts, the entire bridge is pre-cast at a plant some 20 miles distant by water.

Across the main ship channel that runs north and south through San Francisco Bay, there are four 300-foot fixed steel spans, with a central lift span of 303 feet. The remainder of the bridge between shores is of concrete viaduct construction, supported on concrete piles driven to bedrock. The concrete viaduct has 35-foot spans in the main channel and 30-foot spans across the shoals.

The concrete viaduct is supported on four concrete piles in each bent. Approximately 5000 piles were used in the construction of the viaduct sections, the longest pile being 105 feet in length and weighing 34 tons. The piles vary from 18 by 18 inches to 24 by 24 inches. The deck is 27 feet from curb to curb, with a four and a half foot railing on each side.



DECK-SLAB CASTING PLATFORM

All pre-cast units were cast in a yard 12 miles north of the bridge site. This platform, on which short slabs weighing 46 tons and long slabs weighing 55 tons were cast, is 1500 feet long

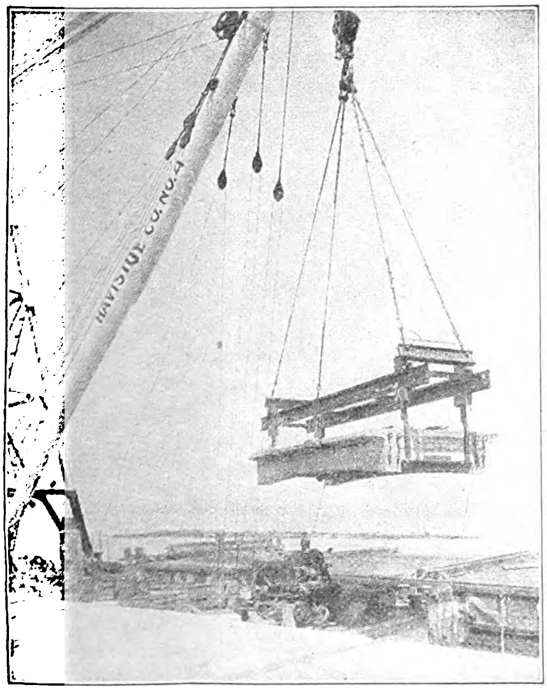
THE contractors adopted a unique plan in which the girders and decking combined were pre-cast in half sections, weighing as much as 55 tons each. The four pile bents were capped on the site and when the caps were sufficiently hardened, the pre-cast deck slabs were placed approximately in position, being supported on wooden blocks 12 inches square The pre-cast deck slabs were then lined up with hydraulic jacks having ball-bearing bases, which made it possible for one man to move one of the 55-ton slabs. When the slabs were in position, the load was taken up with screw jacks which were left in position until the joints were concreted and the load taken up by the concrete, after which they were removed.

The placing of the pre-cast slabs was done with the largest floating derrick on the San Francisco Bay, having a capacity of 100 tons, which handled the slabs without any difficulty and without damage.

A special device was used for picking up the slabs. This consisted of a heavy steel girder frame equipped with four heavy steel arms, two at each end. These arms were so designed that they could be moved back and forth on the steel girder to enable the device to pick up different sizes of slabs.

AN open space of 10 inches was left between the ends of the deck slabs, to allow for the locking arrangement designed to hold the sections of the bridge together in the event of unusual stress that might be put upon them by reason of earthquakes, or by out-of-control shipping, driven against the bridge by the wind. One longitudinal bar in each girder projects beyond each end of the girder in a loop. These loops are threaded by a steel rod extending across the entire bridge at each bent and are embedded in the 10-inch concrete joint between the slabs.

One of the most interesting features of the bridge construction is the specially constructed pile-driver with four leads used in driving the piles. This pile driver is equipped with two steam pile-driving hammers for driving two piles at once. The driver equipment includes a steel derrick 135 feet in length which is used to lift the piles from barges and place them in position in leads of the driver. A special four point suspension has been worked out for picking up these immense piles. The piles were lifted from the barge and when in a vertical position, three points of suspension were removed and the pile was supported and handled by heavy cables and a special clamp, the clamp being bolted to the four vertical reinforcing bars. A pile was placed in each of the four leads of the driver and then the two hammers were lowered into position for driving and two piles were driven simultaneously and expeditiously.



SLAB-HANDLING DERRICK

Deck slabs were lifted by this 100-ton derrick from the barges and placed on the bridge bents

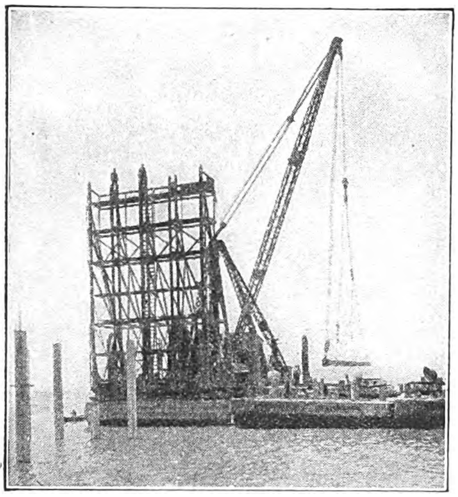
All the fence posts were cast in place, and then the pre-cast rails and curb were set. The solid appearance of this curb and rail adds greatly to the sense of safety when driving on the bridge.

As stated previously, the length of the bridge is 7.1 miles, only one mile of which is over deep water, the remainder being on tide flats with water ranging from one to four feet deep at low tide. In order that the floating equipment might work the entire length of the bridge, it was necessary to dredge a channel eight feet deep by 165 feet wide and five miles in length, entailing the movement of 1,400,000 cubic yards of material.

IN addition to the pile and pre-cast slab structure there are four 300-foot steel spans and one 300-foot lift span, supported on concrete piers. The lift span will have a clearance of 35 feet above mean high water when closed, and 135 feet when raised.

One of the interesting features in connection with the construction of this bridge was the plant where the concrete piles and the pre-cast slabs were made. The casting yard was over 1500 feet in length, there being one yard with two concrete mixers for casting the piles and another yard with two concrete mixers for casting the slab sections, the largest of which weighed 55 tons each. Between the two casting yards railroad tracks were laid with a capacity for storing 60 cars of aggregate used in the concrete.

A specially-built gantry crane having a span of 85 feet and operating the entire length of the slab-casting yard was used in handling the pre-cast slab sections. This crane was equipped with a specially-built device for picking up the slab sections from the forms and was very similar to the device used at



FOUR-LEAD PILE-DRIVER

An immense machine which places four piles at a time and drives two at a time

the bridge site for lifting the sections from the barges and placing them in position in the bridge. This device was supported from a crane traveling laterally over the top of the gantry and was provided with four heavy steel arms, two of which hooked under each end of the slab.

The slab forms were used 13 times, and were so arranged that the entire form remained in place with the exception of one side form for each rib, which could be dropped down, together with the end bulkheads. This enabled the gantry crane to lift the slabs directly from the forms and place them on the barge for transportation to the bridge site. The slab for each bay was cast in two units.

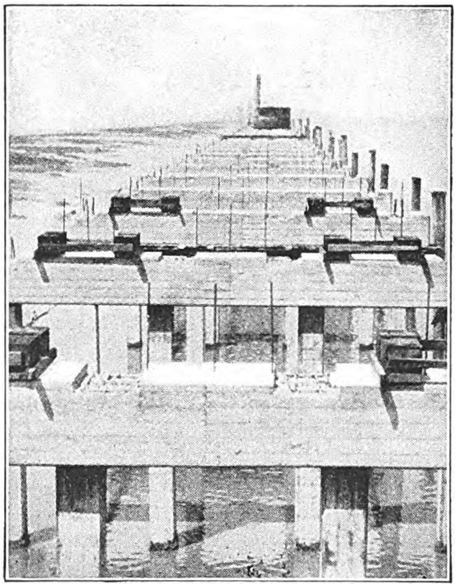
A GANTRY crane with a 125-foot span was used for handling the concrete piles and for loading them on the barges used in transporting them to the bridge site. This gantry crane was equipped with an immense steel girder or beam which carried four sets of blocks and cables for picking up the concrete piles, the weight of the piles being self-equalized through the blocks and cables on the lifting beam or girder. All piles up to 77 feet long had three pick-up bolts cast in place, and those over that length had four. These were T-headed bolts with a steel plate and nut on the bottom end. After 24 hours in the concrete, they were given one twist to break the bond. They were removed after the piles were placed on the barge and the holes filled with neat cement grout.

It may be of interest to note that, in fabricating the reinforcement, a radical change was made from the usual custom of placing the hoops in spirals around the vertical rods. The hoops were all cut to proper length and placed parallel to each other, thereby effecting considerable economy since this permitted a considerable number of men to work on the fabrication at the same time. The completed reinforcements were then placed in the forms with the crane.

By casting the slabs in this yard and then transporting them to the bridge, all the usual "false work" or use of wooden forms at the bridge was made unnecessary. The slabs were kept wet for 11 days before shipping, by covering with burlap and sprinkling with movable sprinklers.

While this is the longest highway bridge in the world, its total cost will not run beyond 7,500,000 dollars.

In order to connect the bridge proper with the main arteries of travel on the east and west, approximately five miles of graded approaches are required. A considerable section of these approaches was constructed through salt ponds, the embankment through these being graded by means of bucket dredges.



READY FOR THE SLABS

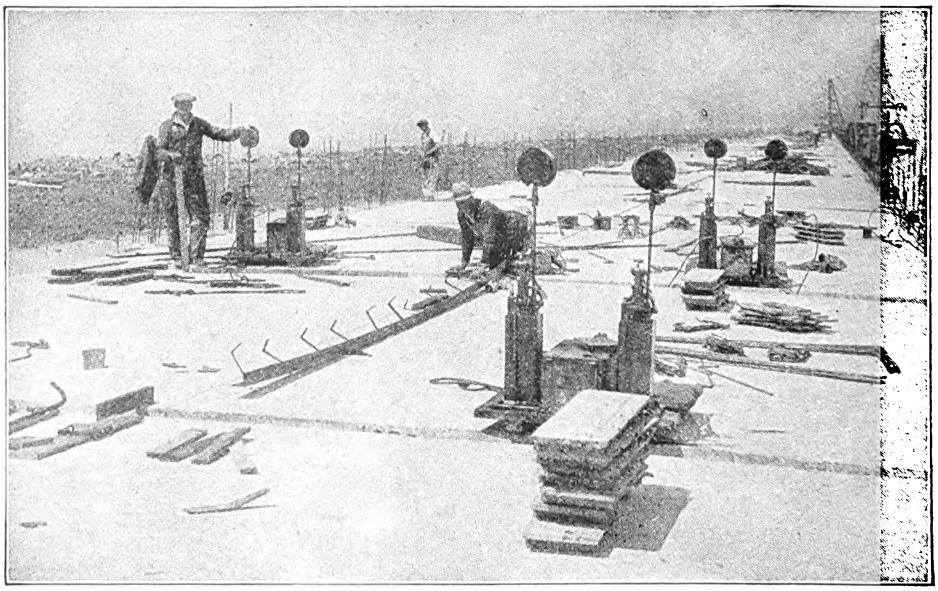
A few of the 5000 piles needed, in place with pile bents capped ready for slabs

These dredges operated from a borrow pit paralleling the approaches. Instead of following the customary method of putting a temporary pavement on the new fills, they were paved at once with a permanent concrete pavement On top of the embankment, there was placed a layer of red rock varying in thickness from six to 12 inches, according to the condition of the fill. This rock was thoroughly rolled and the concrete pavement laid on top of it. With the exception of one or two places of short length, it is not believed that there will be any serious settlement.

It will be of interest and value to watch these approaches as time goes on, and compare the cost of upkeep of the pavement with the cost of maintaining a temporary pavement and then replacing with a permanent pavement after the settlement has ceased.

THE building of this bridge is an outstanding example of efficient organization and rapid construction. The bridge company was incorporated in September, 1927, with all financing accomplished; the first contract was let and work was started in the casting yard on January 2, 1928. Approximately 250,000 dollars was spent in adapting as a concrete casting plant a section of the Alameda yards of the Bethlehem Shipbuilding Corporation on the Oakland Estuary. The preparation of the yard was completed and the first pile was cast on March 1; the first slab was cast on April 3; and the first pile driven in place on the same day. Since that day, progress has been so rapid that the last pile was driven the latter part of October, the driving of these piles being greatly facilitated by the special pile driver.

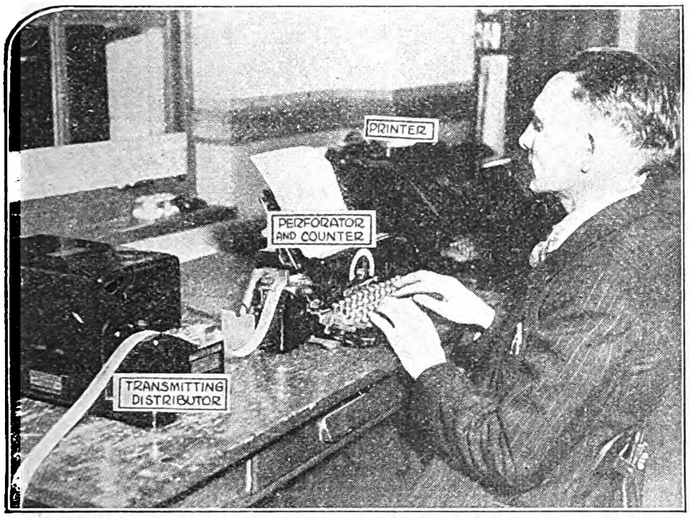
The bridge is being constructed by the Raymond Concrete Pile Company.



BINDING THE DECK SLABS TOGETHER

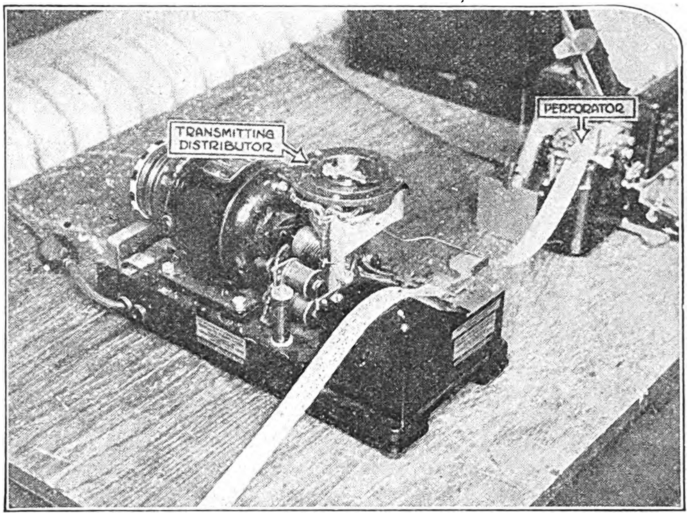
In addition to the three quarter inch expansion joints at every fifth slab, there are 10-inch spaces, to be filled with concrete, between the slabs. Expansion joints are asphalt-filled

Type-setting by Telegraph



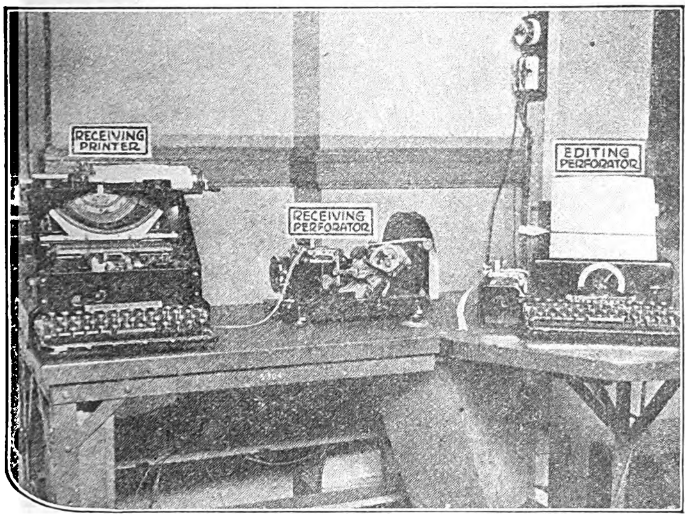
SETTING TYPE MANY MILES AWAY

The equipment at the sending end of the Teletypesetter system. The operator perforates the tape on a machine similar to a typewriter



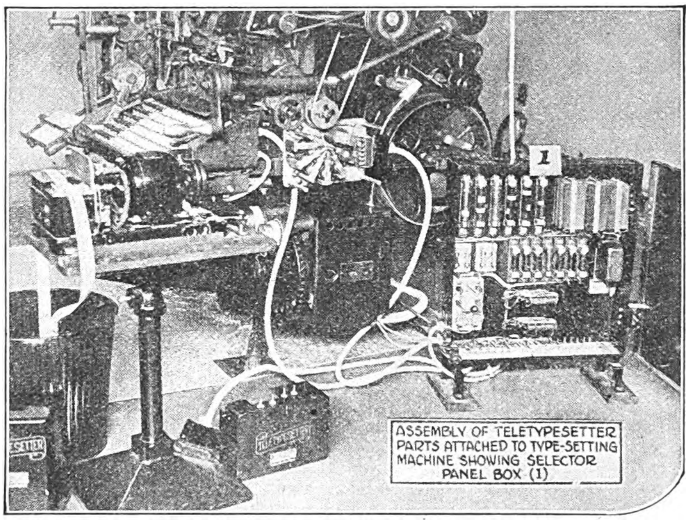
THE SENDING EQUIPMENT UNCOVERED

The perforated tape passes on through this transmitter which converts the message into electrical impulses for wire transmission



WHERE THE MESSAGE IS RECEIVED

The electrical impulses operate this machine which perforates a tape the same as the original. Another machine prints the message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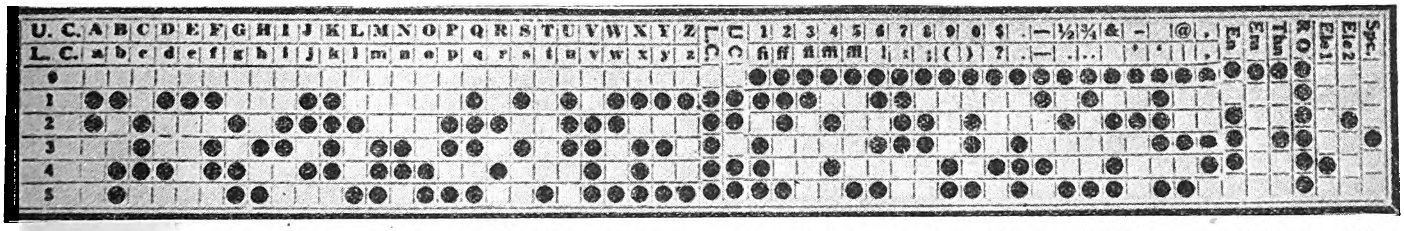
ASSEMBLY OF TELETYPESETTER PARTS ATTACHED TO TYPE-SETTING MACHINE SHOWING SELECTOR PANEL BOX (1)

THE TYPE-SETTING MACHINE CONTROL

The equipment which controls all the operations of the type-setting machine and causes it to set in type the duplicate tape message



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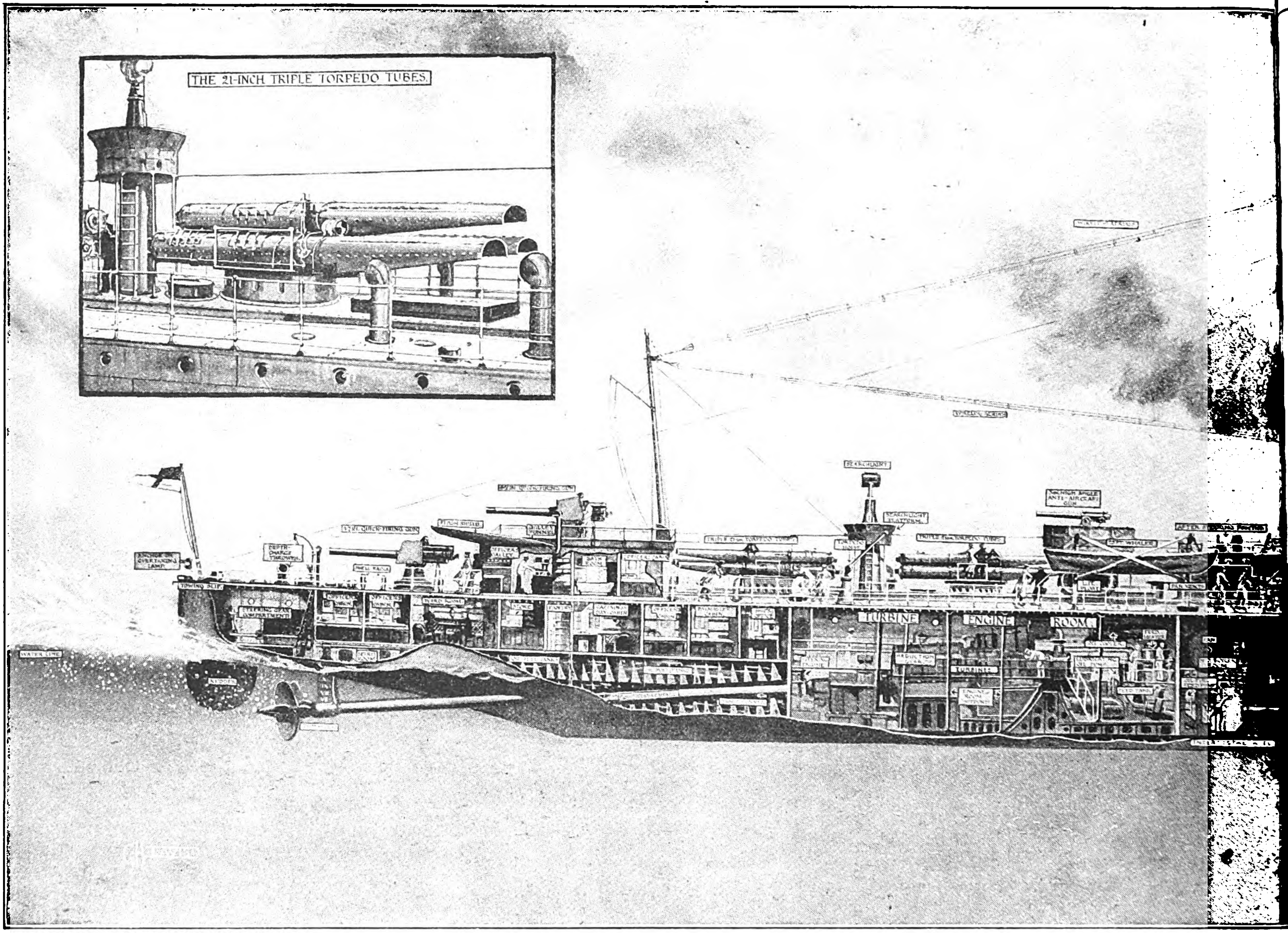
SOME years ago, Mr. Frank E. Gannett of Rochester, New York, publisher of the Gannett newspapers, conceived the idea of a machine that would set type by telegraph. The result of his initiative in beginning development of such a machine was shown in the recent announcement of the Teletypesetter. Associated with Mr. Gannett in this development are Mr. W. W. Morey of East Orange, New Jersey, and the Morkrum-Kleinschmidt Corporation of Chicago.

The Teletypesetter may be used on either the linotype or intertype type-setting machines. It is not a type-setting machine itself, but operates such a machine automatically by electrical impulses. At the sending end, a machine similar to a typewriter perforates a paper tape in code (see code strip immediately above). This perforated tape, automatically fed into another machine, causes perforation of a similar tape at the receiving station perhaps hundreds of miles away. This duplicate tape is fed into another mechanism which operates a type-setting machine at great speed. A mechanical "printer" also typewrites the message at the same time.

That this machine will have a wide field of use is unquestionable. While it was designed primarily for transmitting news more rapidly over long distances—for example, to a chain of newspapers or to subscribers of a press service—it will be of great importance in book publishing and in sending stock quotations to newspapers. Book publishers using this machine need not save tons of metal plates with which to print new editions but may simply keep files of the perforated tape rolls.


THE 21-INCH TRIPLE TORPEDO TUBES
ANCHOR OR OVERTAKING LAMP
DEPTH-CHARGE THROWERS
TOWING SLIP
STEERING GEAR COMPARTMENT
RUDDER
FLASH SHIELD
OFFICERS' GALLEY
SEARCHLIGHT
SEARCHLIGHT PLATFORM
TRIPLE 21-in. TORPEDO TUBES
TRIPLE 21-in. TORPEDO TUBES
2-in. HIGH ANGLE ANTI-AIRCRAFT GUN
27FT. WHALER
TURBINE ENGINE ROOM
TURBINES
ENGINE ROOM SUPPORTS
FEED TANK

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A British Destroyer

Great Britain and Japan Have Built Many Ships of Thi
World War Experience. Th

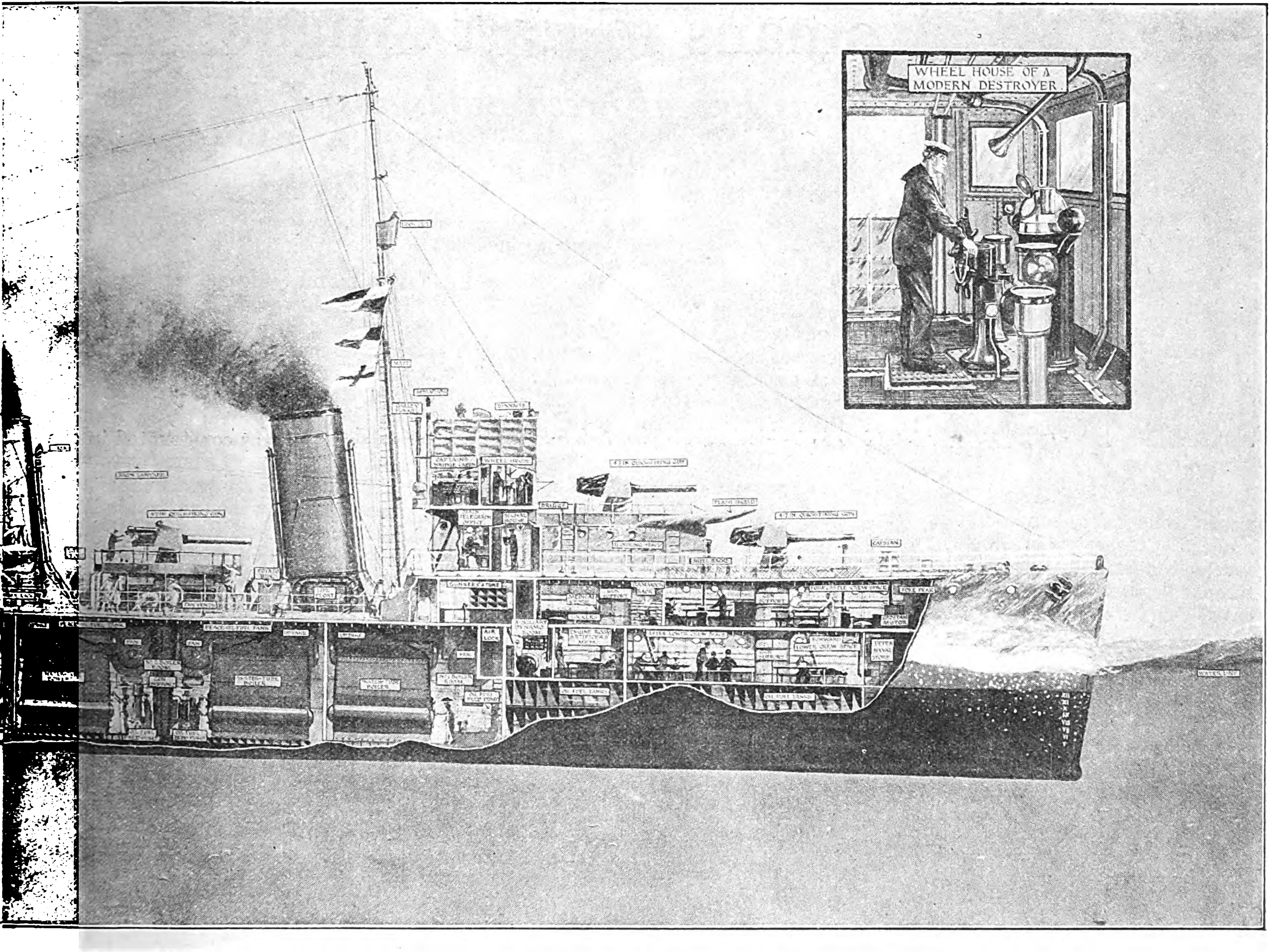
FOR its particular class of service, the destroyer is an extremely efficient small vessel, but the destroyer flotilla leader illustrated here is even more powerful. Before discussing it, however, it is well to review briefly the destroyer's history in order to understand better the potentialities of this super-destroyer.

With the advent of the automobile torpedo, there was developed a small but deadly naval ship called the torpedo boat. To combat these boats, which were used as early as the Spanish-American War, the torpedo boat destroyer was built. This ship was equipped with a number of torpedo tubes and was supplied with several guns of small caliber. In the process of its development, the destroyer became literally a shell crowded with the machinery necessary to make it a speedy, easily handled ship. It was apparently a weak ship but actual war service against German submarines proved it to be a very effective weapon. In this kind of warfare, its speed and seaworthiness were vitally important features.

HAVING demonstrated its value, the destroyer was improved during and following the war. Its size was increased; it was given more torpedo tubes—often as many as 12—and appreciable gun-power; and more powerful propelling machinery was installed. Thus the modern destroyer, an offshoot of the larger classes used during the war, is a high-speed vessel so seaworthy that, despite its relatively small size, it can remain with the fleet at sea for limited periods.

But even modern destroyers are very vulnerable due to their shell-like construction which, in turn, is due to the necessity for speed. They are effective, of course, against submarines but they cannot attack larger ships except in numbers. Attacking, *en masse*, their preponderance of torpedo tubes affords them a measure of fighting power not to be ignored.

While destroyers are primarily anti-submarine vessels, they have other important uses. During the war, they were used as escorts for transport convoys, a service for which they are peculiarly adapted because of their speed and maneuverability. In those days, they carried a large number of depth charges—as many as 50 of these deadly "bombs" being carried by some—so it will be seen that their effectiveness is not limited to the guns and torpedo tubes they possess. They are


WHEEL HOUSE OF A MODERN DESTROYER
MAST
BINNACLE
WHEEL HOUSE
BRIDGE
SIGNAL HOUSE
4.7 IN. QUICK FIRING GUN
CAPSTAN
SHELL RACKS
GUNNER'S STORE
MEDICAL STORE
HAMMOCK RACK
GUN SUPPORT
FORECASTLE CREW SPACE
FORE PEAK
CAPSTAN MOTOR
AIR LOCK
AUXILIARY DYNAMO ROOM
ENGINE ROOM ARTIFICER'S MESS
AFTER LOWER CREW SPACE
FORWARD LOWER CREW SPACE
UPPER NAVAL STORE
OIL FUEL TANKS
LIFE FLOAT
UPTAKE
FAN
WATER TUBE BOILER
WATER LINE

Leader—We Have None

Important Type Which Was Developed as a Result of United States Has Built None

also valuable for laying down smoke screens and for acting as anti-submarine screens around capital ships.

Ordinary destroyers are extremely lively and uncomfortable at sea; have limited stowage space and are, therefore, dependent upon bases and tenders; and have quarters for only the ship's complement of officers and men.

Before the end of the war, the need was seen for a faster destroyer, or flotilla leader—a ship that was large enough to accommodate a flotilla commander and his necessarily large staff; that could carry sufficient fuel, ammunition, and supplies to enable it to remain longer at sea; and that was fast enough to "run circles" around the flotilla in taking advantage of tactical opportunities. Besides these features, the flotilla leader would also have to carry extensive radio and signalling equipment and would have to be steady enough to facilitate the taking of observations for torpedo control.

To meet this need, a type was developed that has since become known as the destroyer leader. Destroyer leaders carry the same torpedo equipment as destroyers, have greater gunpower, and average in the neighborhood of 2000 tons displacement. The largest ordinary destroyers average 1000 tons.

GREAT BRITAIN and Japan quickly saw the military value of destroyer leaders and each has, since the war, built a number of them. However, while they have, respectively, 18 of 31,500 tons and 24 of 40,800 tons, built, building, and authorized, it is astonishing to note that the United States neither possesses nor has authorized construction of a single one.

The British destroyer leader illustrated above is of the "Shakespeare" class, is 329 feet long, and has a full load tonnage of 1750. It is a twin-screw ship capable of making 36 knots an hour. Its armament consists of five 4.7-inch guns and a high-angle gun for defense against aircraft. For attack on large ships, it is equipped with two sets of triple torpedo tubes for launching 21-inch torpedoes.

In contrast to this, the *U. S. S. Corry*, a destroyer of the largest type owned by the United States, is slightly over 314 feet long and has a full load displacement of 1308 tons (1215 tons normal). It is also a twin-screw ship and has a speed of 33.97 knots per hour. Its armament consists of four 4-inch 50 caliber guns and one 3-inch 23 caliber anti-aircraft gun. It has four sets of 21-inch torpedo tubes.

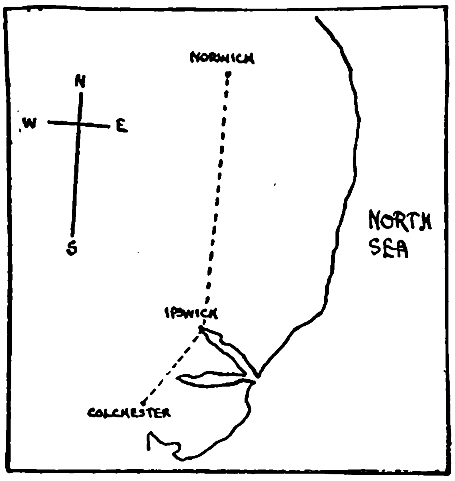
The Romans in East Anglia

New Excavations Reveal Fresh Evidences of the Roman Occupation of Ancient Britain

By J. REID MOIR
Fellow of the Royal Anthropological Institution, Member of l'Institut International d'Anthropologie
Past President of the Prehistoric Society of East Anglia

THE AUTHOR

DURING the turbulent times of the Roman raids into England, which resulted, finally, in the subjugation of the whole country, East Anglia played a not unimportant part. In fact, one of the largest Roman garrisons was at Camulodonum (the modern Colchester in Essex), where for well over 200 years, many of the famous legions were quartered. Excavations in the town of Colchester have revealed a vast quantity of evidence of the Roman occupation. The museum at this place contains a priceless collection of specimens of this period of English history.



Drawing by the Author

A PART OF EAST ANGLIA

Figure 1: "East Anglia" loosely designates an old Anglo-Saxon kingdom

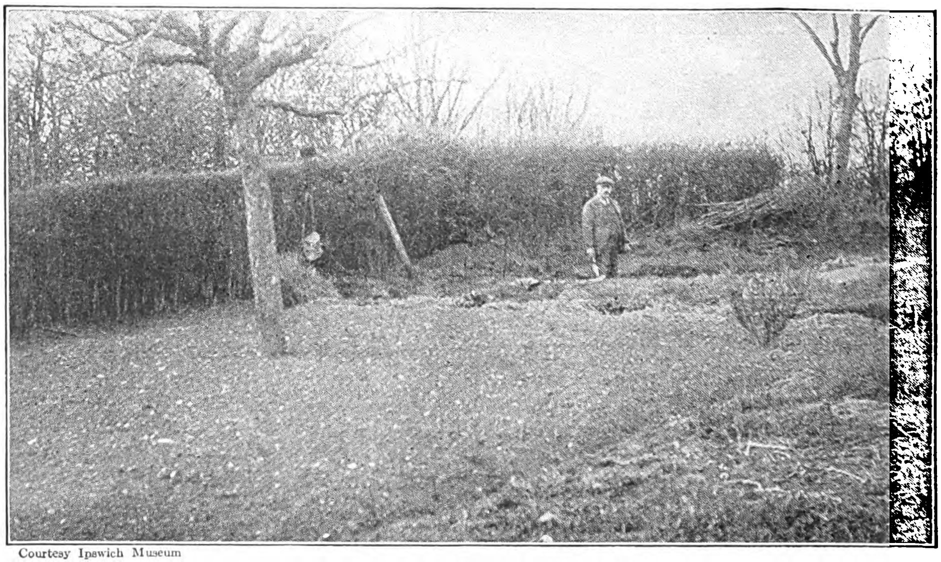
Ipswich lies about 18 miles northward of Colchester and was connected with it by a well-made road which continued past the former town to the well-known Roman encampment of Caister near Norwich (Figure 1). Thus Ipswich was situated between two large centers of Roman activity and was not, in consequence, regarded in those days as a place of much importance. It is evident, however, that farming operations were carried on in many parts of the fertile land of eastern Suffolk, while it may be supposed that some of the high officials at Colchester had houses in the neighborhood which were used as headquarters for hunting expeditions. Some 30 or 40 years ago, during excavations at a place called Castle Hill, to the north of Ipswich and adjoining the Roman road running from Colchester to Caister, a large piece of decorated tessellated pavement was unearthed; and at a later time a great *amphora* or wine vessel, said at the time of its discovery to have been full of Roman coins.

DURING the past season, in order to find out more about the Castle Hill site, I undertook diggings there which have resulted in a series of discoveries which have thrown a revealing light upon the past history of this place (Figure 2).

Castle Hill, a significant name considering what has now been found there, occupies a commanding position from which in Roman times, before the town of Ipswich was built, splendid views must have been obtained down the beautiful estuary of the River Orwell; while to the southwest the road to Colchester, with its no doubt considerable traffic, would have been clearly observable. The excavations I have carried out have revealed two acres of tessellated pavement, which formed the floors of a room and a passage, respectively (Figure 3). These formed, evidently, the back portion of the house where the kitchens were situated; as nearby were found large numbers of animal bones, chiefly ox and pig, together with numerous oyster and snail shells, the remains of the ordinary Roman bill of fare.

The house was built upon a gently sloping hillside, and to accommodate itself to this the place was constructed at three different levels, communication to each floor being by steps. The building had, probably, a central courtyard, and was constructed in one story only. From the outside it must have resembled a modern bungalow in appearance, and was very well built, as is clear from the solidity of the remains of the walls which have been found, which after 16 centuries are still of an extraordinary hardness and strength. They were built of flint pebble, while the inside of the rooms were evidently decorated with colored plaster work in panels and having, chiefly, designs of foliage. Great quantities of fragments and pieces of this interior decoration have been recovered and the colors of the painting are still wonderfully clear and well preserved. With a floor composed of decorated pavement and the paneled walls, the villa at Castle Hill must have presented a very pleasing appearance, and have been an artistic and well built residence.

IN one of the rubbish pits examined, usually fruitful in finds, a bronze gold signet ring was discovered set with a nicolo stone upon which is engraved a seated figure. There were also found bronze dice and gaming counters, earrings, carved bone hair-pins, a colored



Courtesy Ipswich Museum

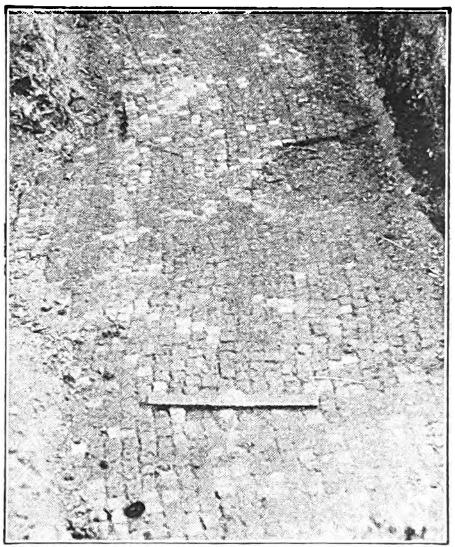
WHERE THE EXCAVATIONS ARE TAKING PLACE

Figure 2: The site is at Castle Hill near the city of Ipswich. The workman is standing upon the uncovered tessellated pavement. East Anglia abounds in archeological interest

glass medallion, bronze bracelets, and other objects in the same metal. Large numbers of pieces of broken pottery and roofing tiles were discovered, one of the latter still retaining the bronze nail with which it had been fastened. Some coins were also unearthed, and these are referable, as is the bulk of the pottery, to late Roman times.

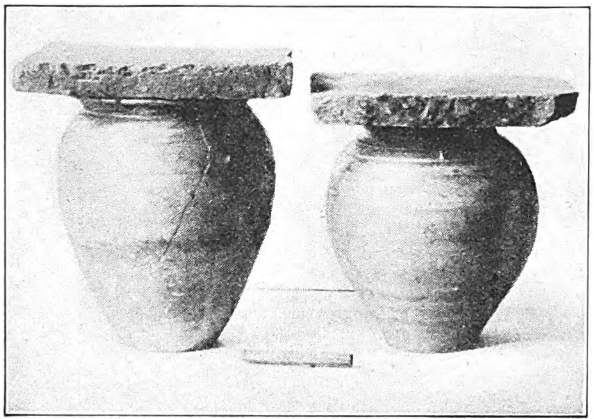
A LITTLE to the south of the site of the villa were found two cooking vessels of large size (Figure 4) placed side by side with their mouths covered by Roman tiles. These had evidently been used as cinerary urns, as in them were discovered burnt human bones. It is unusual to come across evidence of cremation in the late Roman period, when inhumation was generally the practice. This was clearly shown by a find I made a little time ago of what was evidently the cemetery of the villa at Castle Hill. The place is about a quarter of a mile south eastward of the villa, and is situated on rising ground overlooking a small valley. Here were discovered upwards of 45 skeletons, in many cases buried with food vessels and other cultural objects (Figure 5). The bodies had been laid out full length with their feet pointing to the east, thus showing that the people were Christianized, but the presence of food vessels in the graves indicates that the old pagan ideas had not been completely eradicated

In the passageway of the villa already mentioned were found the remains of two small fires, which perhaps are of significance. When the Romans finally departed from England a very dark period of English history was inaugurated. In fact, we do not know exactly what did happen then, but it is probable that the times were very turbulent and invasions of East Anglia by people from across the North Sea frequent. It may be supposed that these people would camp in the abandoned buildings of the Romans, and not being accustomed to such places might be likely to light their fires in any room or passage which took their fancy. So the presence of charcoal in the passageway at Castle Hill may point to the occupation of the place by Anglo-Saxons who had invaded Suffolk.


Courtesy Ipswich Museum

PART OF THE FIND

Figure 3: View of a passageway of tesselated pavement in good condition


Courtesy Ipswich Museum

TWO CINERARY URNS

Figure 4: Originally these were cooking vessels which, like their later occupants, had become timeworn

The excavations of the Ipswich villa are to be continued, and there is little doubt that further interesting discoveries will be made. In the neighboring farmyard are several huge blocks of dressed stone of Roman date, which point to the existence at this spot of a large and important building. A small stone coffin of this period is also preserved at the farm, and this offers the prospect of unearthing the burial place of the owners of the villa, which by the poorness of the grave furniture in the cemetery already mentioned, is evidently not represented there.

No signs of any fortifications have been found at Castle Hill, which fact points to the tranquility of the district under the Roman occupation, and to the complete subjugation of the native population. When, however, it is remembered that this villa was built after the Romans had been established in England for over 200 years, this state of affairs need cause no surprise. The invaders occupied the country for almost 400 years, and without doubt brought order and good government into what was, even with the comparatively advanced civilization of the Iron Age, a very backward country.

The Romans have left the signs of their occupation indelibly impressed upon England. Their wonderfully made and straight roads, the remains of their massive and handsome buildings, and the great walls they built in the north from one side of the country to the other, remind us of the colonizing skill and ability of this virile, tough-fibered race.

THE work being carried out at Castle Hill, Ipswich, is revealing yet one more intimate glimpse of the manner of life of the ancient Romans, and enabling us to realize how very "modern" was much of their civilization. Perhaps they suffered, as do many of the present day, from too much luxury in living, and it is evident that they used a prepared and cooked diet, because the teeth of most of the skeletons found possessed damaged and decayed teeth. Thus, at least 1600 years ago in England, the populace was suffering from the same dental ills which are so exercising the minds of those interested in the public health of today.

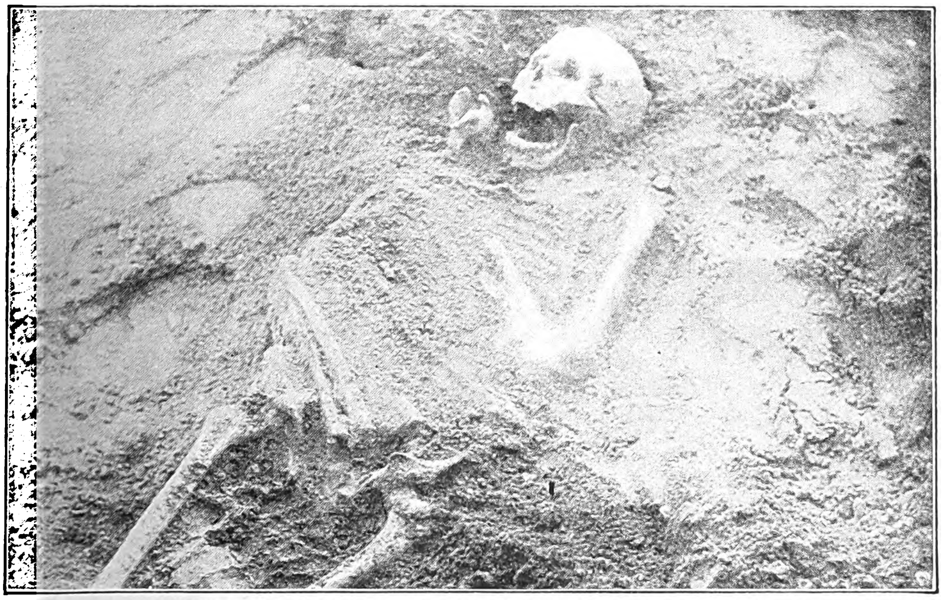
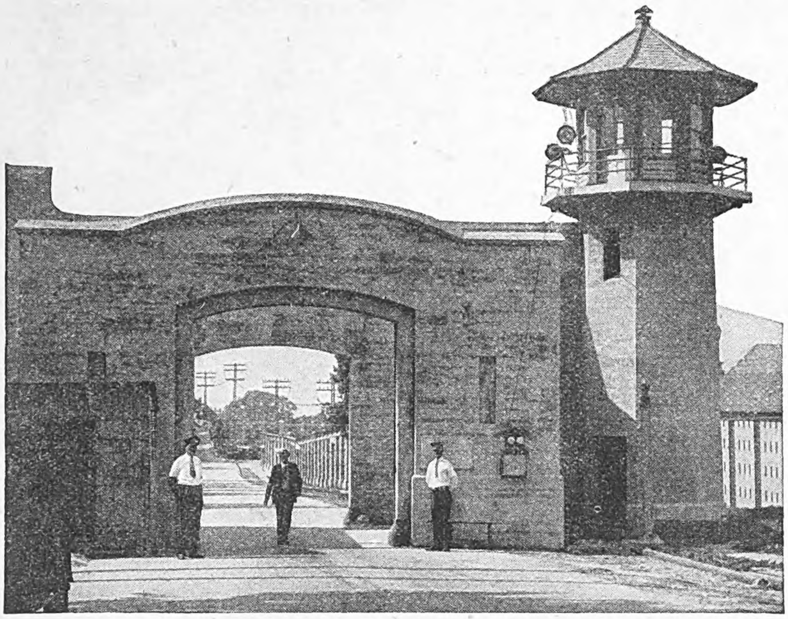
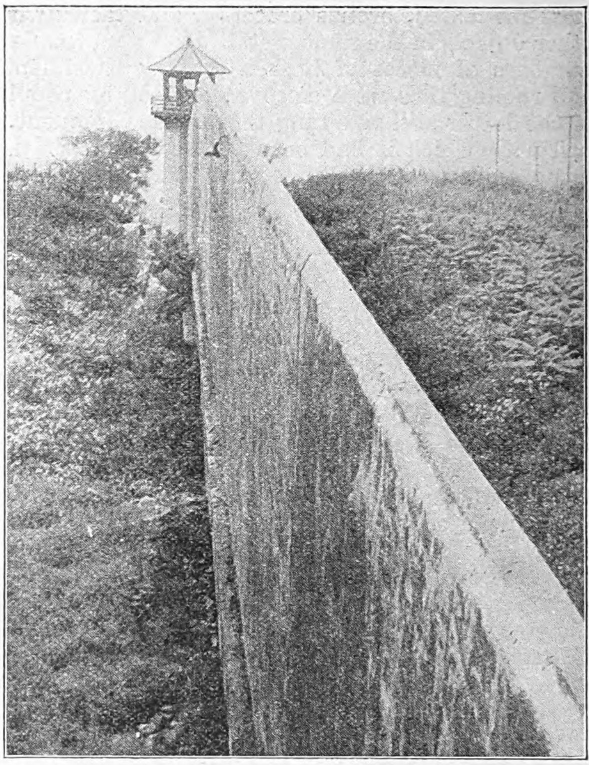

ROMAN SKELETON PARTLY UNCOVERED AT IPSWICH

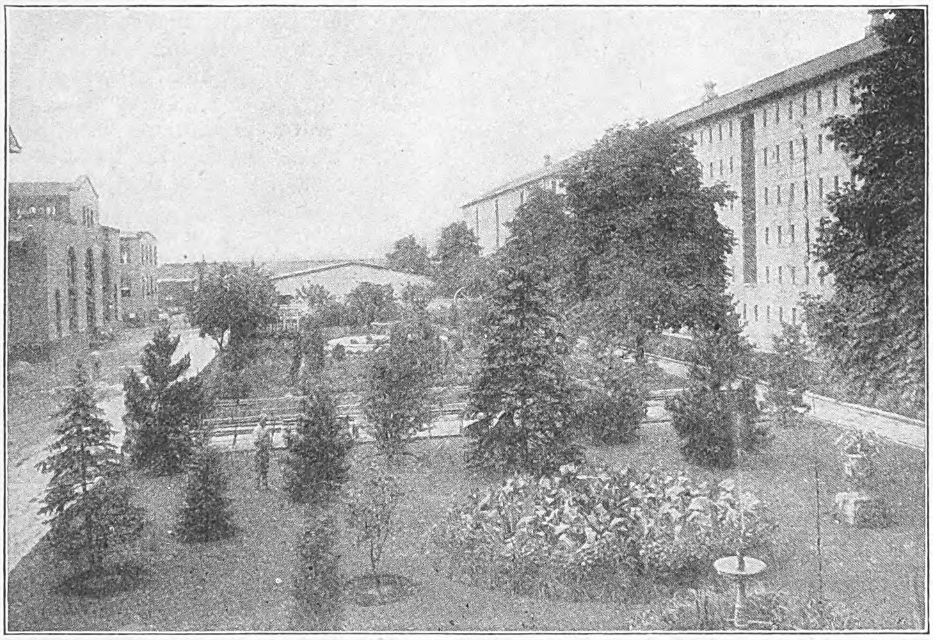
Figure 5: In order not to damage the skeleton the work had to be performed with small hand trowels. It takes a considerable length of time and not a small amount of skill





PROTECTING SOCIETY ▲ ▶

An entirely new entrance (above) forms part of the three quarter mile fence (right) which is 30 feet high. There are nine guard-towers manned day and night by armed guards. At night the wall is swept by searchlights on the towers. There are 70 acres in the enclosure. The new administration buildings on the left of the gateway shown above will house the warden's and other offices, reception rooms for prisoners, and visiting rooms

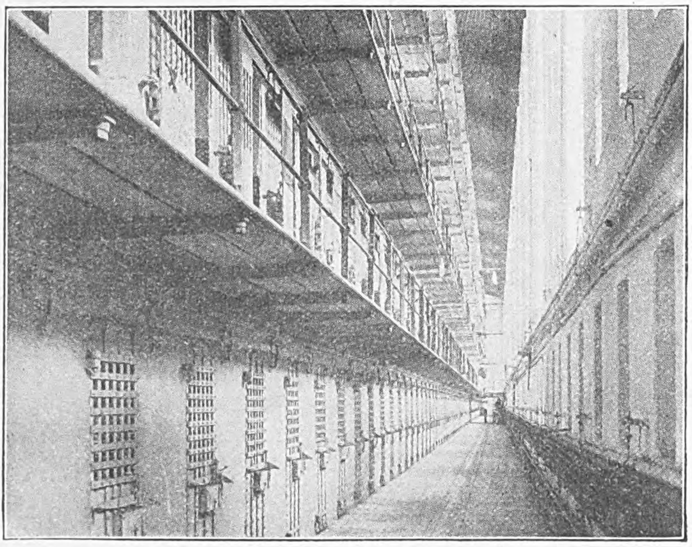


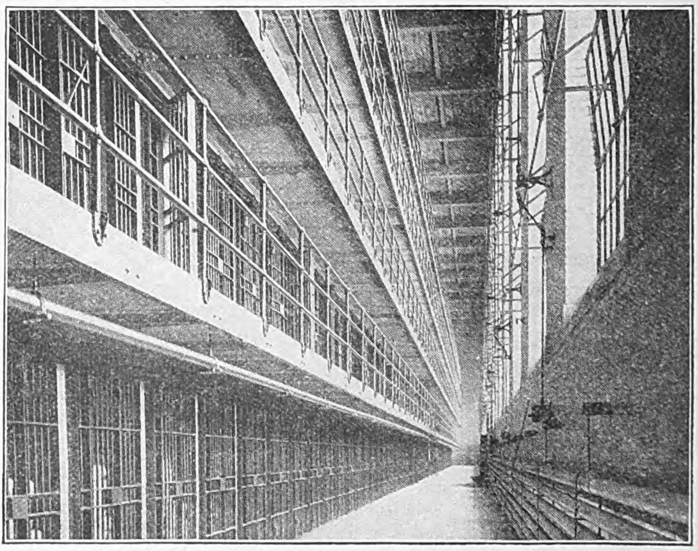
◀ THE PRISONERS' GARDEN

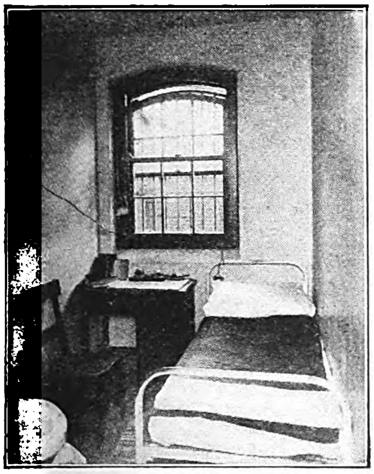
The prisoners like flowers and pets and here they are allowed to follow their bent; even a bird house is being built. The grim cell block a century old was condemned 60 years ago. Splendid new prisons on the hill at the right will soon make this inhuman prison a thing of the past—a relic to be banished from mind

CELLS OLD AND NEW

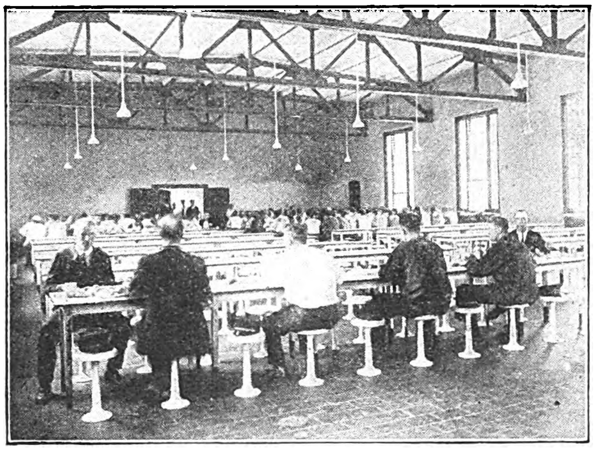
To the left below we see some of the 935 cells in the 104 year old cell block. The cells are all stone, measuring about three by seven feet. The only ventilation is through the grilled top of the door; sanitary accommodations are a slop bucket. Here the men are locked up from dusk to 6:30. All heat comes from the corridor. The cells in the new prisons are shown on the right below. The cell doors are open grilles. There is a toilet, a wash basin, a bed, a chair, and even a desk in each cell



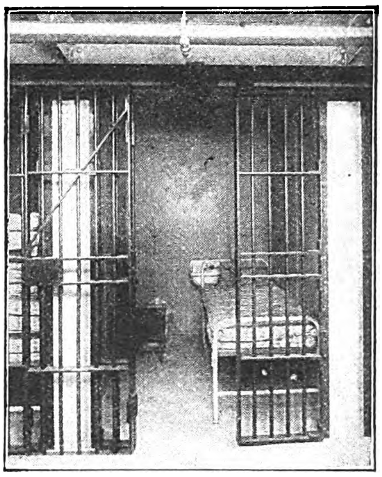




A BRIGHT CELL
Some of the new cells provide windows and comparative comfort



CLEANLY MESS HALL
A number of mess halls in the new prison supply coarse but adequate food. Twenty-one cents a day does not afford much opportunity for epicurean luxury



A HUMANE CELL
While not roomy, the cells are comfortable and above all, sanitary

Sing Sing Past and Present

Society Segregates and Educates the Anti-Social in the World's Most Famous Prison

THERE are 20 reasons for crime, according to Warden Lewis E. Lawes, of Sing Sing, but it is largely a matter of temptation, time, place, and circumstance. Although often mentally deficient and nearly always anti-social, criminals must be confined for the safety of the public. Shall we simply jail them until their time is up and they "get the gate" or shall we prepare them so that they will not continue to war against society? The warden believes that while the men must be safely confined, that a common sense understanding of the problem indicates a mean course between harshness and emotional pity. The prisoners know why they are there and what they want is a square deal, and nobody is as critical as a prisoner.

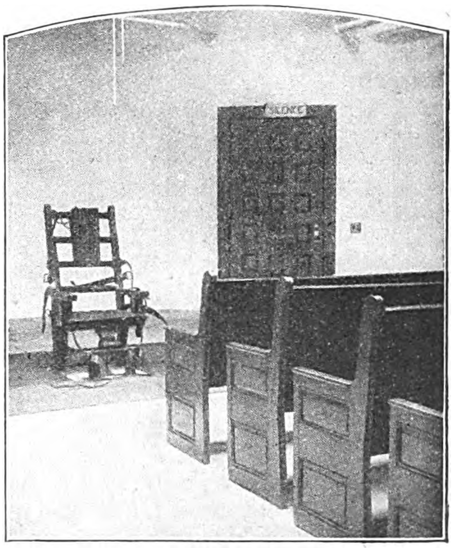
Certainly the physical condition of the jail warranted the expenditure of the 5,000,000 dollars which the new buildings have cost. Some of these prisons are now being occupied and in a short time the old cell house, a cruel and disgraceful structure built 104 years ago, will be a thing of the past, unless utilized for storage. The old cells are like tombs with ventilation only through the upper part of a door, and of toilet facilities there are none. The building was condemned 60 years ago; finally money was appropriated for a new prison. The new buildings are on high ground on a bluff overlooking the Hudson. The buildings are all connected and the prisoners can reach the shops along the Hudson by tunnels.

New prisoners are usually brought through a steel gate into the old prison where they are classified and subsequently measured by finger printing and the Bertillon system. They are then bathed and rigidly examined for drugs or dangerous instruments. The prisoner is given a number and he becomes a member of a community of about 1700 souls.

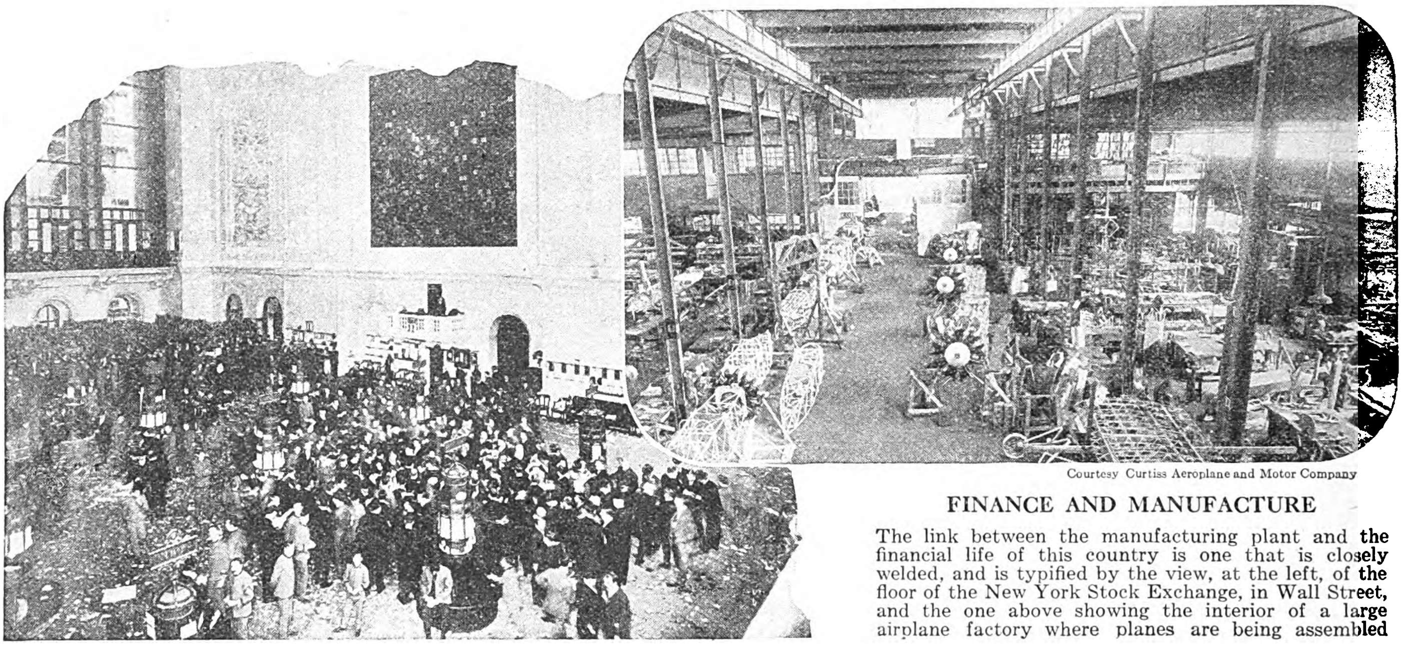
The first work is shovelling coal, but in time the principal keeper, the physician, the psychiatrist, the head teacher, and the director of industries have all had their chance to pass on the man. Why all this trouble? In the first place it is to help the prisoners from a humanitarian point of view and to return them to society better than when they went in.

The new death house, called the "condemned cells," is in a new 300,000 dollar building. The "chair" is a humane method of execution. The first shock is at a potential of 2000 volts. This is reduced to 500, then built up to 2000 again and the operation repeated until two minutes are up. Unconsciousness takes place in a 240th part of a second. The law requires an immediate autopsy.

LET us see how the prisoner's day is employed. The gong sounds at 6:00 A.M. and the men are checked up. At 6:30 they turn out of their cells. Breakfast is served at seven. At 7:50 the whistle blows, the men are counted again, and the day's work begins. At 12:00 o'clock the whistle blows and the men go to their respective mess halls for dinner. The day the writer visited the prison each man received cabbage, two slices of corned beef, two boiled potatoes, butter, and three slices of bread. Being the day before Thanksgiving, biscuits were added. The men pass in front of a steam table and receive their food. Coffee is served at the table. At 12:50 work is resumed after another count. Work ceases at 4:00 P.M., when a light supper is served. The allowance per man is 21 cents a day, so luxuries are absent. All "Grade A" prisoners may purchase food up to three dollars a week to supplement the prison fare. After supper the prisoners have a period of recreation and when dusk comes the men are counted and locked in their cells. There are often moving pictures to be seen. At 9:30 a final count is made and the lights are soon turned off and another day brings the prisoner nearer the "gate."



THE CHAIR OF DEATH
The execution chamber has a gripping interest. It is a part of a prison within a prison. "Condemned cells" are segregated



Courtesy Curtiss Aeroplane and Motor Company

FINANCE AND MANUFACTURE

The link between the manufacturing plant and the financial life of this country is one that is closely welded, and is typified by the view, at the left, of the floor of the New York Stock Exchange, in Wall Street, and the one above showing the interior of a large airplane factory where planes are being assembled

Investing in Aviation

The Recent Boom in the Aviation Industry Has Made it Doubly Necessary for the Prospective Investor to Investigate the Situation Thoroughly

By PROFESSOR ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City, Corresponding Editor, SCIENTIFIC AMERICAN

PRIOR to the World War, American aviation was not at all on an industrial basis. It was considered a toy for the wealthy, or a hazardous undertaking best left to inventors and reckless young aviators. Almost the only contact that the public had with aviation was at exhibitions and meets, where the possibility of a fatal accident was one of the main attractions. And accidents, unfortunately, were quite frequent. Although the Wright brothers' first flight was made in 1903, fourteen years after, in 1917, the year of America's entry into the war, public prejudice still had to be broken down, and in spite of all efforts, aviation had not as yet been really popularized.

WHEN the United States did enter into the war, the Army and Navy Joint Technical Advisory Board recommended first the immediate manufacture of 3000 airplanes. The airplane losses of the allies were so high, however, that not 3000, but 20,000 airplanes were needed. Under the general direction of the Aircraft Production Board, the aircraft industry undertook an immense and hurried expansion which, on the whole, was highly creditable. Had the war lasted another year, thousands of war planes and Liberty motors would have been shipped to Europe each month.

At the close of the war in 1918, the aircraft industry employed 27,000 workers with a reported production capacity of 21,000 planes a year. With the signing of the armistice, the aircraft industry paid the penalty of being purely a military adjunct. Invested capital was withdrawn, engineering talent was scattered, and machinery was scrapped.

THE great industrial development of the United States has in recent years been attended by spectacular rises in the values of stocks in such industries as oil, automobiles, rubber, and radio. Both financial authorities and the general public seem now to be convinced that aviation is the next field of great industrial expansion. Eager inquiries are made of men engaged in the aviation industry as to possibilities of investment therein. In view of the widespread and somewhat excited interest in aviation, it is not out of place to analyze the general situation as dispassionately as possible, and point out some of the possibilities which might be overlooked by the layman.

Manufacture for the government was reduced to a minimum and a huge amount of war material was thrown on the market, thus obviating the production of commercial aircraft. Civil flying activities were reduced to the operation of the "gypsy flyers," young aviators who purchased cheap war planes and earned a precarious living carrying passengers, or "barnstorming;" that is, traveling from place to place giving exhibitions. For three or four years the industry was at its lowest ebb.

IT is interesting to record the various events which transformed this dismal situation to the present brilliant one. In 1918, the United States Post Office Department established an experimental air line between New York and Washington. While this was soon abandoned, the air-mail service developed the air line between New York and San Francisco division by division. Night flying, over lighted airways, was also persistently and skillfully developed. On July 1, 1924, the transcontinental service was established, and attracted such patronage with its 36-hour service, that by July 1, 1925, the air mail had flown 9,839,000 miles and carried 261,987,120 letters.

These successful operations led Congress to pass the Act of February 2, 1925, authorizing the Post Office Department to contract for the private operation of existing routes, and for the establishment of new routes, also privately operated. By September 1, 1927, the Government had withdrawn from all air-line operation. Not only Congress, but the aircraft industry itself, had been steadily opposed to all forms of subsidies. The rapid and successful development of private air lines has fully justified this policy.

Then there came the Air Commerce Act of May 20, 1926, which called for the appointment of an Assistant Secretary for Aeronautics in the Department of Commerce, with duties calling for the regulation of air traffic and the licensing of pilots and aircraft. Under this act, Congress appropriated 300,000 dollars for "Aids to Navigation"—the installation of beacons and lighted emergency landing fields along existing contract air-mail routes.

Next, the Navy Five-Year Aircraft Program Act, approved on June 24, 1926, allowed for the construction of 1614 airplanes, and an expenditure of 85,078,750 dollars during a five-year period. The Army Five-Year Act, July 2, 1926, provided for a great increase in the Army Air Corps personnel and for obtaining 1600 serviceable airplanes.

These two acts provided a tremendous stimulus to the aircraft manufacturing industry. The Air Commerce Act was calculated to raise the confidence of the public in the safety of flying, and of financial interests in the stability of commercial aviation. Together with the Kelly Bill, authorizing the private operation of air-mail routes, it rapidly stimulated the growth of air transport.

THE year 1926 would have been a banner one for American aviation with no other happy events. But there were yet other aids to advancement of the industry. Henry Ford entered the field as an aircraft builder and operator, creating a decided impression on both public and capital. The National Air Transport Corporation was formed with a Board of Directors composed of some of the most prominent men in American finance, business, and industry.

In the meantime, planes and engines had been steadily improving in speed and reliability. Many important adjuncts such as lighting equipment and radio beacons had reached a high degree of usefulness. Many of the "gypsy fliers" had vanished from aviation in the lean years of the industry. Others had settled down as fixed base operators. A branch of aviation, distinctively American in character had arisen, under the name of Aerial Service.

Aerial service is a collective term which includes aerial taxi work, crop dusting, photography and survey by air, flying instruction, forest fire patrol, and a dozen other activities. In no European country has it reached anything like the proportions attained in the United States.

The year 1927 was clearly showing the benefits of all these governmental, engineering, and commercial influences when there came the historic flights of Lindbergh, of Chamberlin and Levine, and of Commander Byrd and his associates. Lindbergh's flight in particular was the spark that aroused universal enthusiasm and interest in aviation.

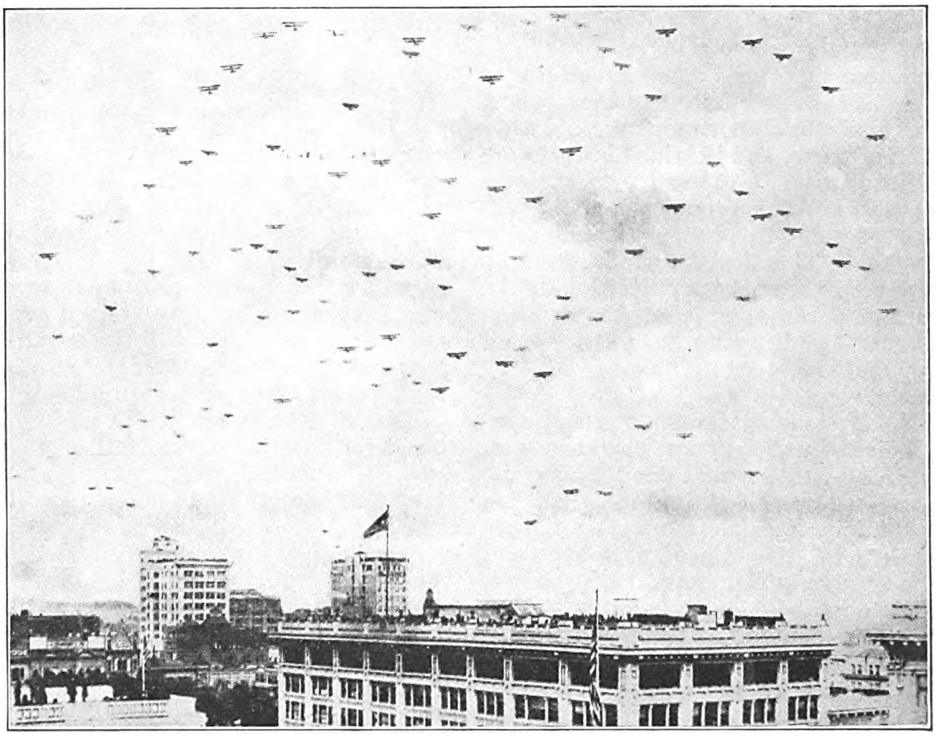
The progress of American Aviation since Lindberg's flight has been breathtaking and apparently it is at the time of writing marching forward as rapidly as ever.

It is interesting to consider some statistics of airplane production. According to data collected by the Bureau of the Census, production since the war has been:

Year	Total number of planes built	Total Value —Dollars
1919...	662	
1921...	302	
1923...	587	
1925...	789	6,673,659
1926...	1186	8,871,027
1927...	1962	14,512,999

These figures show a remarkable increase for 1927. Moreover, the Bureau of the Census figures may not be complete. So many airplane factories are engaged in building planes that competent authorities consider the number of planes built in 1927 as being closer to 3000.

The figures for 1928 will, in all probability, be much larger when they are finally tabulated. All the factories in regular commercial production during 1927, announce larger production for 1928. With some, the production is to be doubled or even tripled. A plane a day no longer strikes the airplane builder as an extraordinary output. One factory announced an output of 25 machines a week during 1928.



THE SKY IN THE FUTURE?

This is an actual, unretouched photograph of a mammoth army demonstration of aerial maneuvers presented recently at San Diego, California. Will such scenes soon be common?

SOME enthusiastic observers predict that the complete figures will show an output of 15,000 planes for 1928. This number is probably too optimistic, but it is quite reasonable to expect the construction of 4000 planes with a value of between 20,000,000 and 25,000,000 dollars.

Production methods have kept pace with increased production. In the early stages of aircraft construction, every part of the airplane was built painfully by hand. Metal fittings were cut slowly out of flat stock. Wooden ribs were built by cutting out strips of wood of various sizes and by glueing small pieces of wood and plywood together. Fuselages were built with a complicated fitting at every joint. Now duralumin ribs may be stamped out in a single operation. Hand-made fittings are replaced by stampings, forgings, or castings. Particularly in the construction of fuselages, fittings are avoided altogether by the use of welded joints.

Sales have kept pace with production. It is not uncommon for a manufacturer to state that he cannot make deliveries under ninety days. All the principal manufacturers have unfilled orders on their books. Instances are related where responsible business men have visited plants and produced certified checks for 100,000 dollars in a vain endeavor to secure early deliveries on planes.

The increased safety of the airplane and the great increase in the number of landing fields lead many sportsmen and other well-to-do men to think of private ownership, for pleasure, and sometimes for commuting purposes over long distances.

Young America wants to follow in the footsteps of Lindbergh. Flying schools all over the country are besieged with applicants. As soon as a young man has learned to fly, he wants to have his own plane. The tendency for young people to own planes for pleasure or sport is being encouraged by the formation of flying schools and flying clubs throughout the country.

Large business houses have become aware of the possibilities of the airplane in sales work, in emergency distribution of parts, and in trips of inspection by executives. At least forty business houses now own planes for business purposes and this number is increasing rapidly. The airplane can be used by doctors in sparsely populated districts, and by ranchers, prospectors, surveyors, and men in many other occupations.

THE steady extension of aerial service of various types also means an increase in the purchase of airplane equipment. The rapid, nation-wide extension of air transport means more outlets for the sale of passenger and mail planes. Therefore, it can be predicted without much hazard, that there will be both a steady and a rapid increase in the sale of airplanes for all purposes.

The possibility of increase in the number of planes sold has been fully realized by every one connected with aviation and has led not only to greatly increased production by established manufacturers but also to the incorporation of many new companies. There are at the present moment more than one hundred and fifty plane manufacturers in the United States and new producing companies are announced almost daily.

The automobile is severely restricted as to general dimensions and design, but the airplane can be a monoplane, a biplane, or a triplane. It can be a "flivver" plane of twenty-foot span, or a giant seaplane of one hundred and fifty-foot wing spread. Therefore it is improbable that the airplane will ever be as standardized as the automobile. But it is susceptible of greater standardization than, for example, water craft. From a standardization and concentration point of view, airplane manufacture should, therefore, lie somewhere between the automobile and power-driven water craft. With greater diversity of types, there is perhaps room for more plane factories than for automobile factories.

Nevertheless, it is a significant fact that there were once upon a time some two hundred automobile factories, and that out of these less than twenty remain to-day and that, while enormous fortunes have been made out of the automobile, there have been as many failures, drastic re-organizations, and unpleasant receiverships.

In aviation, there is a similar mushroom growth of builders, a good portion of whom will disappear, as time goes on, under the pressure of competition, consolidation, and other powerful factors. Some of the factories, on the other hand, will undoubtedly eventually reap success and huge profits.

The first class of manufacturer to be considered is that of the factory producing exclusively for the Army and Navy air services. It is an open secret that many such manufacturers have made comparatively large fortunes. The number of government contractors is not permitted to increase. The five-year army and navy programs give them assurance of continued, steady business for some years to come.

SUCH factories are, as a rule, privately owned, and are now responsible, well conducted concerns. If an investor finds an opportunity to buy into such an organization, with a well-established record of earnings and friendly relationships with the government, he may rely on a steady and large return on his investment. The possibility of the investment becoming a splendid speculation, however, with capital multiplied many times, is not so promising. Such factories have become more or less stabilized and, since they are exclusively engaged in government business, expansion of their business is necessarily limited.

The factories which may be considered to be in the strongest position of all are those which, while having a secure hold on government business, have also found it possible to undertake the construction of commercial planes. Their government business should keep them steadily employed, no matter what the state of the market may be. Their commercial plane business gives them the opportunity for indefinite expansion.

Only one such airplane company is listed on the New York Stock Exchange. The price of its stock is at present perhaps too high, partly due to the speculative boom, and partly to the general public's enthusiasm for aviation. At the first real depression in price, it should be an excellent purchase for a long term investment.

There may be some real bargains in the stock of recognized airplane factories having this double foothold, which have not yet given proof of earning power. They will be in a position to take advantage of any further growth in the airplane market, and because they are not earning as yet, there may be all the more reason for the purchase of their low-priced stock by investors who do not need immediate dividends.

Then come the companies which are engaged in the building of purely commercial airplanes. Some of these, in existence for several years, started in a humble manner, and have grown to large proportions. These factories are mostly to be found in the middle west. They took advantage of the sale of large numbers of OX-5 engines, which the government threw on the market at prices as low as 50 dollars each, and built small two-seater or three-seater machines at a price under 2500 dollars. As a result of this policy, they achieved large sales and efficient production. These companies operate with small executive and engineering staffs, and are worth careful consideration.

THE OX-5 engine of 90 horsepower is disappearing. It will have to be replaced by air-cooled engines of similar power or greater power at a price of between 2000 and 3000 dollars instead of an average of 200 dollars each for the OX-5 type. The prices of planes will have to go up to meet this situation. If the manufacturers of low-price planes can overcome this handicap by forced price increase, they will undoubtedly have a brilliant future before them.

So far we have been discussing classes of plane builders whose stock the general public has found difficult to obtain. The companies whose stock is readily available to the public, or is even thrust upon the public, are the new companies recently formed or now in process of formation. There is a serious danger that the public may lose large sums of money by investing recklessly in such companies.

There is, to begin with, already a sufficiency of plane builders. The success of the mid-west manufacturers was predicated on the availability of the cheap OX-5 engine, which can no longer be counted upon, and on the fact that when they started out, they had little or no competition to meet. To-day, competition is keen.

A new company should have a first class engineering staff. The mid-west manufacturers did not, in their engineering work, have to meet the rigid requirements of the Department of Commerce regarding drawings, stress analysis, et cetera. While these requirements are conducive to safety, they also increase cost. Keener competition and continual improvement in design also make further demands on engineering skill. A good pilot, or a first-rate airplane mechanic does not necessarily make a good plane designer.

To build a new airplane, even though it be of a purely conventional type, always costs more money than the enthusiastic designer or promoter anticipates. Even with the most skilled design, there are always chances of error, chances of accidents, or damages on the first trial flights. The time required to build the first machine always exceeds first estimates.

Three or four years ago, it was possible to build five or ten small machines, and to sell them informally through friendly pilots, without much capital outlay. Now it is necessary to begin with sufficient capital and organization to build a large number of planes at once, in order to meet competitive prices. If the formation of a new company is to be justified, it must be dependent on a number of such factors as the availability of a designer of real skill and reputation, backed by men experienced in plane production; adequate capital; adequate plant facilities; the possibility of selecting a type of plane that will not have to encounter too great a competition; or the possibility of building a new type of outstanding excellence.

THE only justification for starting with small resources lies in the possibility of "custom" trade such as the building of air yachts for very wealthy men who are willing to pay as construction proceeds, and to pay more than current market prices. A design of quite exceptional merit may be another such justification, but such designs are very rare.

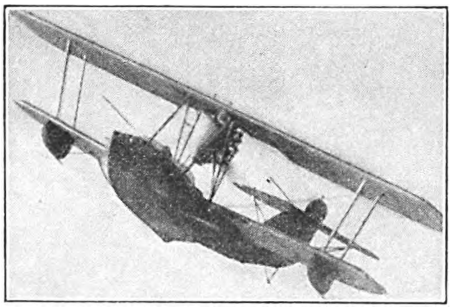
There is not the slightest doubt that plane manufacture offers great opportunities for investment, but such investment requires consideration.

The Airway Map of the United States issued by the Department of Commerce shows the extraordinary growth of the air-mail services since the establishment in 1918 of the first short line between New York and Washington. The Post Office Department is continually asking for bids on new air-mail services and such airway maps are out of date before they are published. The growth of the service is so rapid that statistical surveys also lag far behind the progress made. It is probably best, therefore, to restrict our brief review up to the end of 1927.

First of all, we have a striking chart, prepared by the Aeronautical Chamber of Commerce, of the airplane-miles flown in transport operations on regular schedules in the leading countries of the world. It is at once evident from this that the United States already leads in regular flying mileage, and that the rate of growth is the most rapid in this country. Furthermore, in Europe the air lines have already taken such an extension that their future growth is limited. In the United States the ground has just been scratched.

REFERRING now to the Aircraft Year Book published by the Aeronautical Chamber of Commerce, we find that on or about January 1, 1928, the number of air-mail routes was already 22, all privately operated. The aggregate length of the routes was 11,446 miles.

The total flying scheduled over the 11,446 miles of routes in operation and authorized at the close of 1927 for 1928 exceeded 8,000,000 miles per year. Compared with the 4,128,029 miles scheduled for 1927, the tremendous growth is again emphasized.



Courtesy Ireland Aircraft, Inc.

The aggregate volume of mail carried in the United States in 1927 was 1,485,250 pounds or the equivalent of 59,411,200 letters. Of this, private air mail lines flew 3,823,214 miles and carried 1,001,414 pounds of mail.

On August 1, 1928, a new air-mail rate became effective—five cents for the first ounce, ten cents for each additional ounce or fraction of an ounce. There is not the slightest doubt that this will stimulate the growth of air mail to a tremendous extent, and that the problem of the air-mail operator in loading his plane to capacity will disappear.

An investigation made by the Chamber of Commerce of the United States indicates that chambers of commerce all over the United States are building or encouraging the construction of airports and urging Washington to carry the air-mail service to all centers not served by it heretofore. The chambers of commerce are also using every possible method to stimulate the use of air mail, by such means as personal letters to potential users of air mail, interviews with large users of air mail to discover benefits based on experience, guarantees of a certain amount of air mail per month, et cetera.

The United States Chamber of Commerce has also made an inquiry into the kind of goods sent by air. It is interesting to quote from some of the reports received by this organization:

Los Angeles Chamber of Commerce

"Limited parcel post service comprizes such articles as motion picture films, flowers, automobile supplies, medical supplies, and various articles from department stores, including ready-to-wear clothing, optical goods, et cetera."

Merchants Association of New York

"Millinery, machine parts, special dyes, surgical instruments, jewelry, fish, et cetera."

Oklahoma City Chamber of Commerce

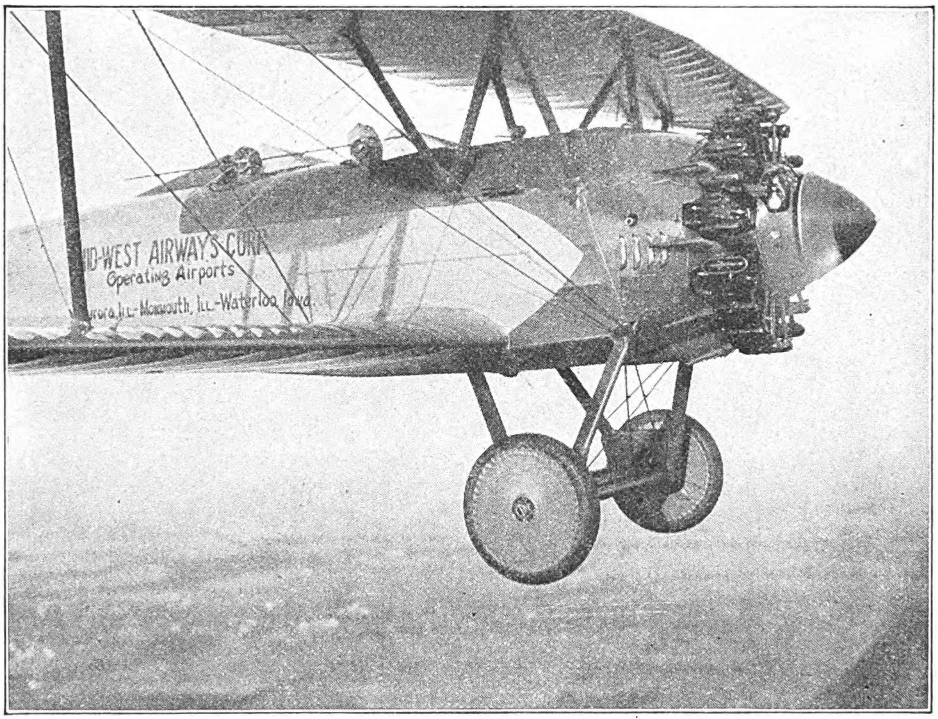
"Articles being sent by air mail from this point include automobile parts, oil field supplies, and almost all classes of merchandise."

IT is a curious fact that in the carrying of passengers by air the United States has lagged behind Europe. This is explainable on a variety of grounds. Very favorable geographic conditions exist on certain European air lines, as for example on the London to Paris routes, where two and a half hours flying is the alternative to eight hours ordinary travel with two changes of conveyance, and a nasty channel crossing in between. In general, air travel in Europe is much more convenient than sleeper travel. It is due further to the greater airmindedness of the European, whom persistent aerial warfare for four years and the use of the airplane for communication between capitals and army fronts has thoroughly educated to the use of the airplane.

Passenger-carrying is, perhaps, less profitable than mail service. In Europe, subsidies for passenger travel have made it a matter of indifference to European companies whether they carried mail or passengers. In Europe, and particularly in Germany, traveling by air is regarded as a patriotic duty for all citizens.

In the United States, the excellency of railway communication makes short hauls by air impracticable. Flying between such centers as New York and Chicago does not mean a saving of time. Eight hours of daylight flying mean far more loss of time than a sleeper ride on the *Twentieth Century Limited,* and aircraft operators are still reluctant to carry passengers by night.

Whatever the reasons, air transport operators were reluctant, until recently, to enter the passenger field. Since Lindbergh's flight, the public has been bringing pressure to bear on the operators and in 1927 well over 8000 passengers were carried in regular air transport. The approximate figures for some of the air lines are as follows:—



Courtesy Advance Aircraft Company

Western Air Express, between Los Angeles and Salt Lake City—400 passengers.

Boeing Air Transport, between San Francisco and Chicago—525 passengers.

National Air Transport, between Chicago and Dallas—168 passengers.

Colonial Air Transport, between Boston and New York—509 passengers.

Pacific Air Transport, between Seattle and Los Angeles—1252 passengers.

Maddux Air Line, between Los Angeles and San Diego—1400 passengers.

Pacific Marine Airways, between Los Angeles and Catalina Island—4200 passengers.

Stout Air Service, in and out of Detroit—1287 passengers.

PERHAPS the most promising recent event from the point of view of air-passenger traffic is the formation of the 5,000,000 dollar Transcontinental Air Transport, Inc., with the National Air Transport, as associated air operators, with the Pennsylvania, the Atchison, Topeka, and Kansas, and the Santa Fe railroads co-operating, and with a Board of Directors composed of eminent leaders in aviation, finance, and railway work. A 48 to 52 hour schedule across the continent, with night travel by train, and day flying across the most promising country, topographically speaking, gives the best promise of safety.

Very important and encouraging also is the pronouncement of General Atterbury, President of the Pennsylvania Railroad, that the railways must not repeat the mistake they made in bus transportation but must make full use of the airplane.

THERE are many problems still to be solved in the safety and comfort of passenger gravel. But it may be concluded without undue optimism that American air passenger travel is now assured of success, and will soon constitute an important source of revenue for the operator of an air transport line.

Enthusiastic promotors of air transport companies and sometimes even well established corporations are apt to under-estimate the expenses of operation. The obvious items of expenditure are gasoline, oil, and pilot's pay. But even with the aids to navigation such as lighting, radio beacons, and weather service supplied by the government, the items of expenditures are many and onerous.

The following list of items in the estimate of costs of a proposed air line, similar to that given in the Civil Aviation report, shows that a good deal more than the cost of planes, gasoline, oil, and pilot's pay has to be taken into account.

CAPITALIZATION
- Airplanes without engines
- Engines
- Special accessories, such as radio, telephones, and parachutes
- Office equipment
- Hangars and their equipment
- Machinery, tools, et cetera
- Supplies and material
- Motor transport
- Operating capital

ANNUAL OPERATING EXPENSES
- Salaries for pilots, mechanics, superintendents, and other operating personnel
- Pilot's mileage
- Gas and oil
- Maintenance and repair
- Telephone and telegraph
- Freight and express
- Motor transportation
- Mileage and expenses of personnel traveling otherwise than by air
- Insurance
- Administrative overhead
- Advertising
- Traffic solicitation
- Miscellaneous

DEPRECIATION
- Airplanes
- Engines
- Other equipment

In scrutinizing estimates of costs, it should be particularly remembered that depreciation and obsolescence for aircraft equipment are still very heavy, and that an annual depreciation of $33\frac{1}{3}$ percent for both planes and engines is none too high. Aircraft insurance also stands at quite a high figure as yet, and adds an important item to the annual expenses.

Detailed estimates of operating costs are not yet generally available. American operators still regard such information as confidential. Therefore Post Office Department cost reports are highly valuable, even though governmental methods of accountancy are not directly applicable to private operation.

THE following is the United States Air Mail financial report for the fiscal year July 1, 1924 to June 30, 1925.

In 1927, the cost per mile of the United States Air Mail had sunk to 0.502 dollars. In 1927 the cost per mile of an important group of private operators averaged 0.671 dollars. Such cost estimates are probably still somewhat unreliable, and will remain so until definite methods of accountancy have fully developed in this new field. Still there seems no reason why operation with single engined planes should not sink to 50 or 60 cents per mile, particularly as operating experience grows.

The greatest source of revenue for the air transport operator has so far been in mail. The operators actually make their bids to the Post Office Department on a basis of so much a pound of mail, at prices varying on different routes from something under a dollar, to the permissible maxium of three dollars a pound.

Even with keen competition on bids, if the operators managed to secure enough mail to load their planes to capacity, they would be on the way to making very large profits. But during the month of May, 1928, they managed to carry only an average of 176 pounds per trip.

Nevertheless, for the period from January to June, 1927, the mail revenue per mile of these operators was 58.4 cents. For the period from July to December, it was 76.9 cents. With the increase in air mail which the five-cent postage will bring, the problem of bringing revenue well above expenditures should be fairly well solved. It is understood that eight air lines showed substantial profits in 1928, although others showed losses. Freight and passenger work will undoubtedly help the air transport operator more and more.

THERE does not seem to be much doubt that air transport is now a sound industry. Investors must still expect a long persistent effort before final success is attained. But ultimately they may expect large rewards.

The only warning to sound is that the prosperity of some of these companies and the brilliant prospects ahead will bring into being many companies without experienced administrative and operating personnel, who will be unduly optimistic in their cost and revenue estimates, who will bid too low on government contracts, and generally court disaster.

In the field of aircraft engine construction, there are three or four companies which have established a solid business with government departments. While there is keen competition for government work, it may safety be said that such companies will continue to receive government orders steadily. The possibility of great expansion rests, however, with those companies which are building commercial engines.

The position of a company such as the Wright Aeronautical Corporation, with a firm footing in both the government and the commercial field and with large resources at its command, can be judged on a basis similar to that of any other well-established concern. Its securities are listed on the New York Stock Exchange. Its balance sheets are available. Its earnings do not seem to be high enough to justify the present level of prices, but there is every prospect that such a company will share to the full in the expansion of business, and that its securities are speculative but sound for the long investment pull.

It is when investing in newly-organized companies, building or about to build engines of between 50 and 150 horsepower, that the greatest caution must be exercised. Investors should bear the following facts in mind:

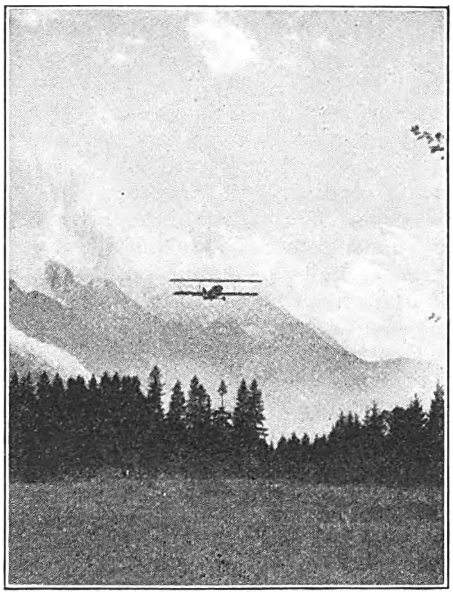
There are some 15 or 16 such companies already in the field.

While the OX-5 engine is disappearing, and builders of planes are preparing to pay as much as 2500 dollars to 2700 dollars for engines of 110 to 135 horsepower, price competition is going to be extremely keen.

No engine, however skilfully designed, can be considered a commercial product until it has passed a government test, and until it has shown reliability and endurance under actual flight conditions. The most surprising defects may show up in practice. An engine is far more difficult to bring to a point of practicability than the rest of the plane.

The equipment needed for the production of the refined aircraft engine is both varied and expensive.

Successful engine construction requires a basically larger investment than successful plane construction.



Service on engines is far more of a problem than plane service. An engine company with a perfect product, may fail completely in maintaining its sales, if it is unable to give adequate service.

The commercial aircraft engine situation is almost chaotic. Investment in commercial engine companies is highly speculative at the moment, although it offers a chance of large profits to those who survive the long pull.

The investment trust has long flourished in Great Britain and is now taking solid root in the United States. Broadly speaking, an investment trust is an organization which makes a careful study of an industry and purchases the shares of many companies in a given industrial field. It offers to the investor a diversified investment, and a high degree of skill in purchase and analysis.

It is extremely gratifying to note that three such investment trusts have recently been formed to invest in aviation securities.

One is Aeronautical Industries, with Lester D. Gardner, former publisher of *Aviation* as its president and with a board composed of bankers, business men, and technicians well versed in aeronautics, but not so closely associated with specific aviation industries as to have their judgment warped. We quote their statement:

> "Aeronautical Industries proposes to furnish the pioneer fund for the expansion of aviation, to explore the entire field of aeronautical investment; to maintain contact with the growth of the aeronautical industry, and through diversification secure for its stockholders the maximum of safety."

The second is the National Aviation Corporation with J. C. Willson as President. The announcement of this group reads:

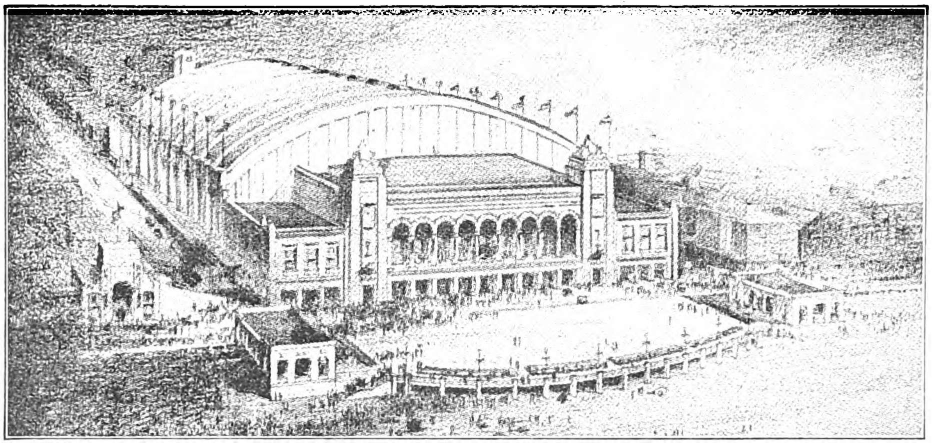
> "About 25 percent of this group represents leading manufacturers in this trade; others are engaged in transport, either of mail, goods, or passengers. This group has come together for the purpose of using the funds of the company profitably by participating in the business of established concerns and by helping to finance new companies as they are organized."

The third and most recently formed organization is Air Investors, whose policy appears to be similar to that of the National Aviation Corporation.

Either corporation may well deserve consideration at the hands of an investor interested in aviation who is convinced of its great possibilities yet is somewhat perplexed by the complex position of the industry.

Our conclusion is that aviation is an industry in which many difficult problems are still to be met, in which many "wild cat" promotions will cause the public to suffer, and in which selection is very difficult. It is, nevertheless, fundamentally sound and has prospects of tremendous expansion, such as no other industry can offer at this time.

CIVIL aviation has progressed to a point where the discussion of the type of plane to buy rivals in interest similar discussions on the merits of various motor cars. With this in mind, Professor Klemin, author of the above article, has prepared a comprehensive survey of the private plane field. This will be presented in March, our special Aviation Number.



All photographs courtesy M. B. Markland Company

AS IT WILL LOOK FROM THE AIR

The architect's drawing of the building which is to be known as the Atlantic City Convention Hall. In exterior design, it is a beautiful adaptation of the Romanesque period

World's Largest Hall Seats 40,000 People

Massive Structure Beside the Famous Boardwalk in Atlantic City, New Jersey, Built to Take Care of Huge Conventions

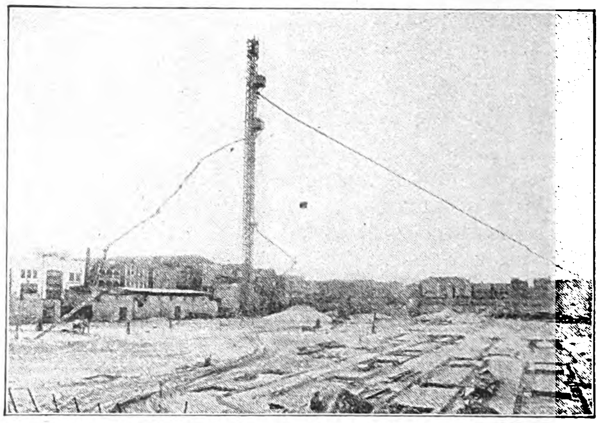
When the general building contractors turn over to the city commissioners of Atlantic City, New Jersey, the gigantic convention hall which has been in course of construction since August, 1926, the United States may again claim another "world's largest" structure. The building, which covers an immense plot 350 feet wide by 650 feet deep, and which will have a total seating capacity of 40,000, will be completely finished about February 1st. The municipality that has built this structure has a population of only 65,000, but the building's particular significance will be appreciated when it is recalled that during special occasions in the summer season there are from 350,000 to 400,000 visitors on the famous boardwalk at one time. Several large associations have already planned to hold conventions in the new hall.

The Atlantic City convention hall is located on the boardwalk directly facing the ocean and between Georgia and Mississippi Avenues. The Pennsylvania Railroad has a terminus on Georgia Avenue and the Philadelphia and Reading Railroad has one on Mississippi Avenue. The building is therefore most conveniently located for visitors and convention delegates.

The excavation for the substructure, or basement, entailed the removal of some 365,000 cubic yards of sand, and due to the loose nature of this foundation material and the fact that seepage of water from the ocean was expected, 12,000 wood piles, each 30 feet long, were jetted into place with a water jet at 60 pounds pressure, and after setting were tapped with a steam hammer. The basement, when completed, was water-tight.

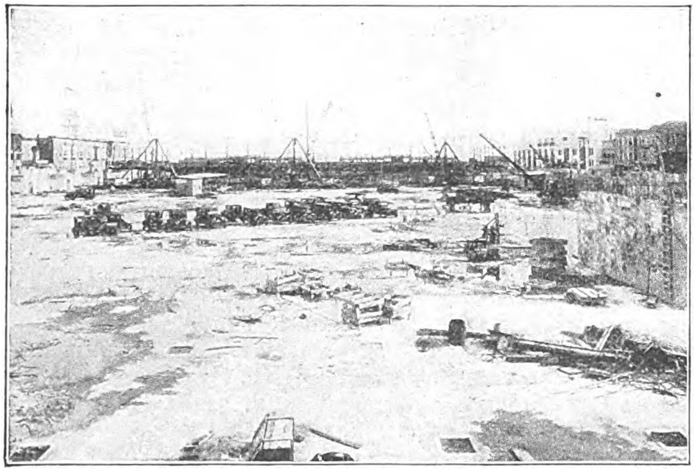
The area of the main auditorium floor is 168,000 square feet with an additional space of 100,000 square feet on the ground floor. The main auditorium has a seating capacity of 25,500 on the floor and stage and 9500 in the balcony and committee rooms. The main auditorium is large enough for all kinds of industrial exhibitions and conventions, athletic games, and indoor circuses.

In addition to the main auditorium there is a large hall 130 feet by 185 feet on the boardwalk in front of the building, which may be used for smaller conventions, art exhibits, banquets, and dancing. This hall will have a seating capacity of 5000 people,



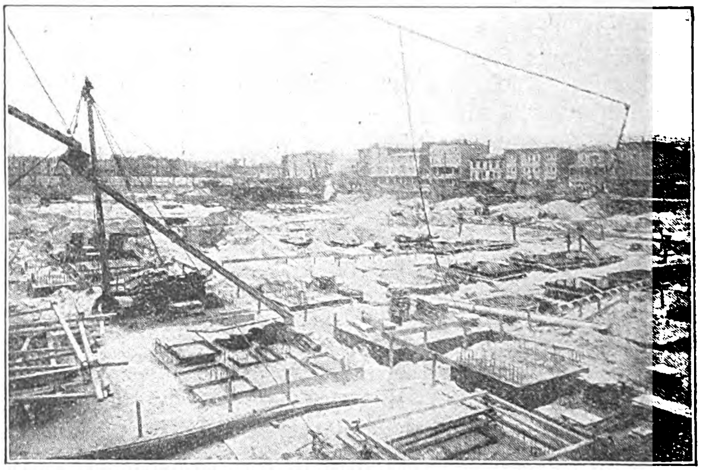
FOUNDATIONS IN THE SAND

Preparing forms for beams and girders which were anchored to foundations to resist the upward thrust



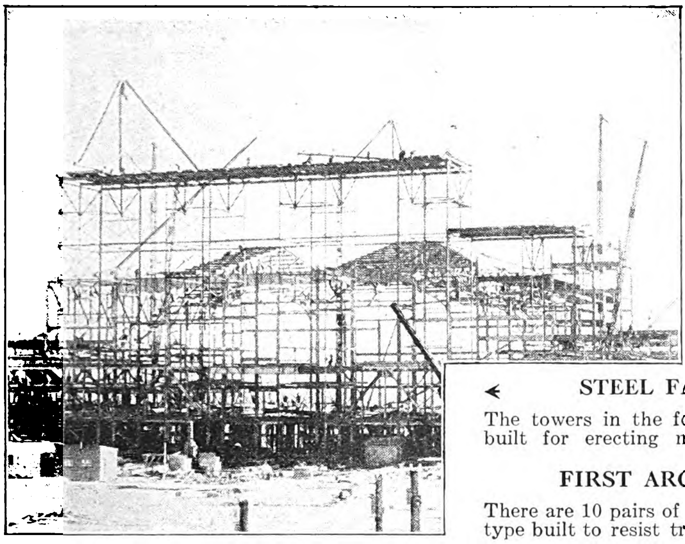
THE HUGE BASEMENT

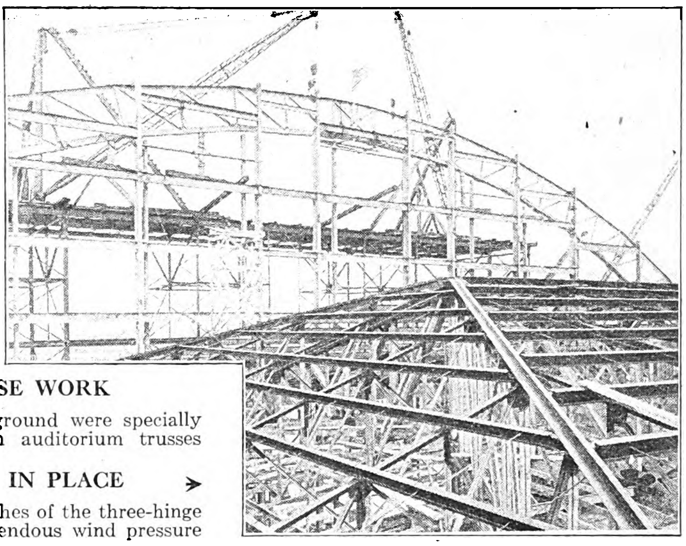
The basement floor and all interior walls were thoroughly waterproofed due to the fact that the basement is below tide level



THE WORK PROGRESSES

Foundations with reinforcing steel looped to anchor floor system. The piles, which resist a lift of 10 tons each, project into the concrete





◂ STEEL FALSE WORK

The towers in the foreground were specially built for erecting main auditorium trusses

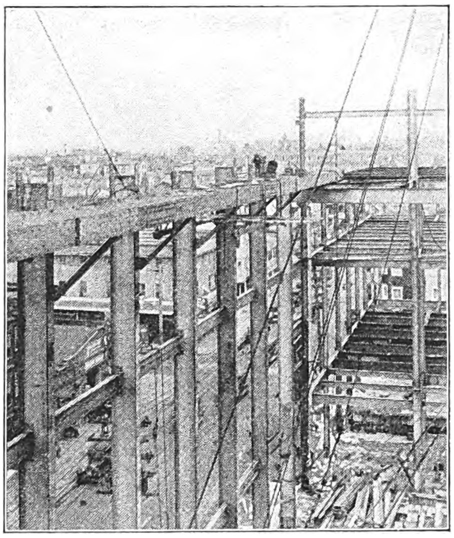
FIRST ARCH IN PLACE ▸

There are 10 pairs of arches of the three-hinge type built to resist tremendous wind pressure

and will include a stage and committee rooms. Fronting the length of this room is a large arched loggia 12 feet wide looking out on the ocean.

On the boardwalk, an arcade about 12 feet wide has been arranged across the face of the building. Along this passage are located 14 shops faced with marble and ornamental bronze, with a large ornamental entrance to the hall, located in the center. Other stores face Pacific Avenue.

THE entrance lobby has a vaulted passage 50 feet wide and about 125 feet long. The walls are of limestone with a ceiling of Gustavino tile and two-tone terrazzo floor with appropriate bronze enframements around the windows, thus giving it a dignified monumental character. Corridors lead from this lobby and connect directly with ramps which lead to the upper and lower levels of the auditorium. Space has been provided on the ground floor to accomodate 400 automobiles. On both Georgia and Mississippi Avenues, terraced sidewalks have been provided in addition to ramp inclines from the ground so that enormous crowds can be handled expeditiously. The building is fireproof throughout.



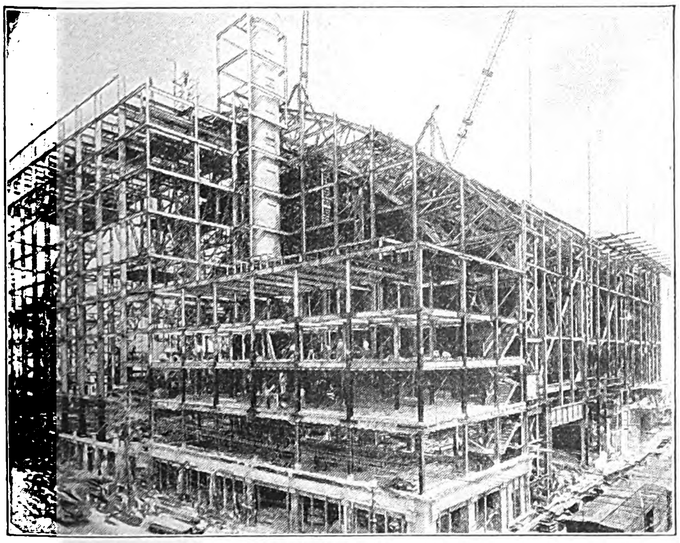
46-TON PLATE GIRDER

This girder was installed to take care of wind pressure against wall in rear of stage

To support the main roof of the auditorium 10 pairs of three-hinged trusses, weighing 220 tons per pair and spaced 49 feet apart, have been provided. These trusses have a clear span of 350 feet and are 130 feet high from the main auditorium floor to the under side of the trusses. These are said to be the largest ever erected in a building of a permanent nature. These trusses and the ceiling are covered with material decorated in a pattern and design of dignified simplicity. Incidentally, the truss ties are built into, and form a part of, the main auditorium floor, a feature which allows all framing attached thereto to move slightly under heavy wind loads and temperature changes.

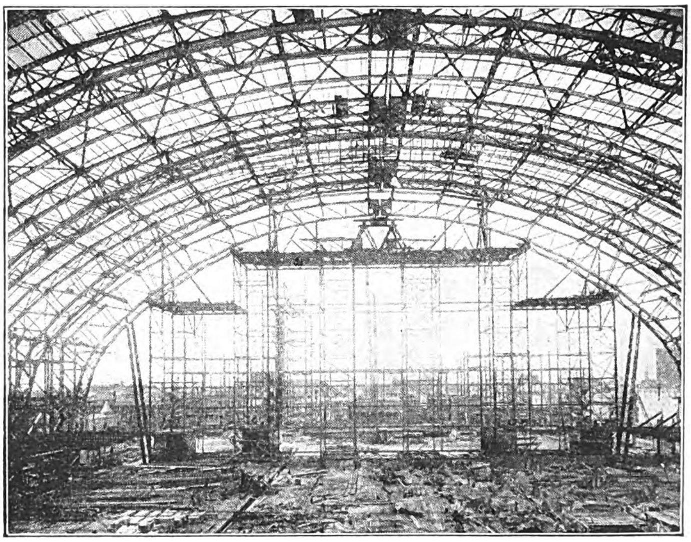
AS is necessary in a hall of this size, careful consideration had to be given to acoustic qualities and a special treatment has been provided whereby with the aid of amplifiers and reproducers, speakers may be heard in all parts of the great auditorium.

The heating and ventilating re-



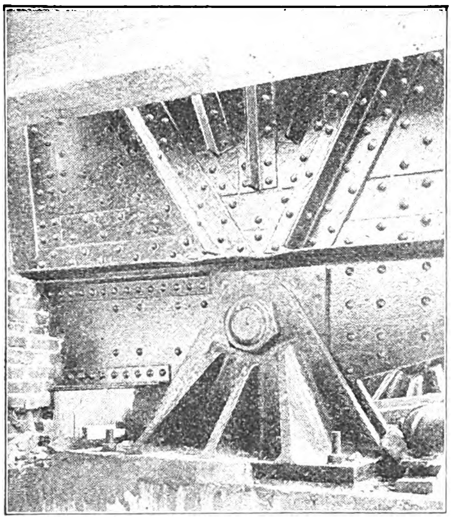
ALL THE STEEL IN PLACE

Steel frame from the stage end of the main auditorium. After second truss was in place, the general contractor erected others



BENEATH THE TRUSSES

The truss-supporting "false work" towers can be seen plainly. The center pin of the three-hinged trusses will also be noted



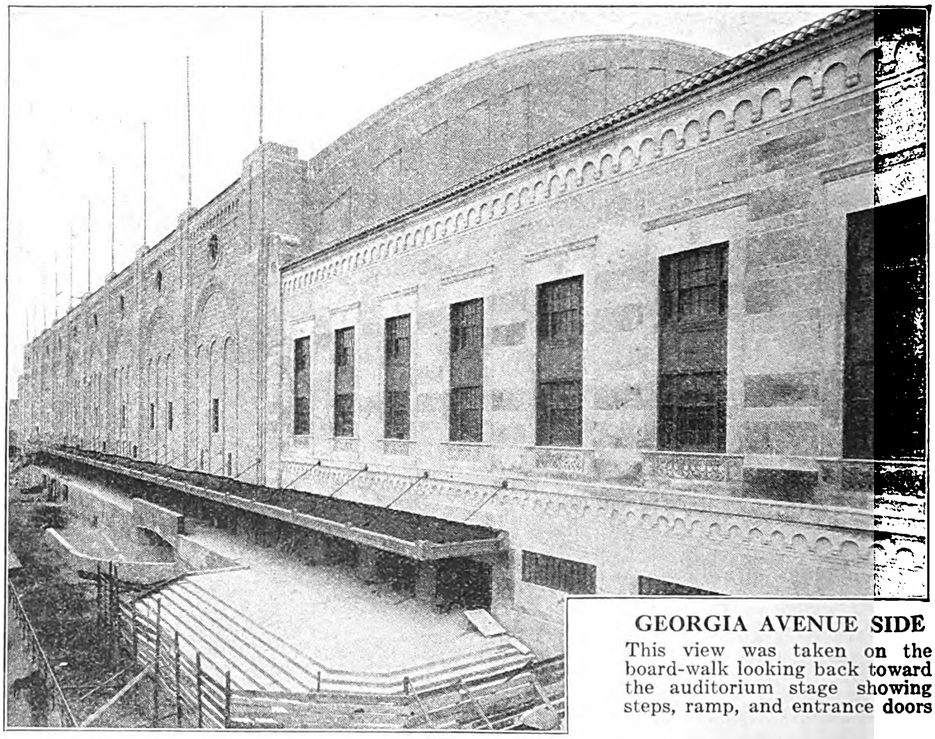
BASE BOLTED TO FOUNDATIONS

The base on one side is rigid and on the other side is set on a rocker nest of rollers

quirements for the auditorium are unusual due to the size of the building. The main hall and ball-room are heated principally by the air which is used for ventilation, provisions being made for re-circulation. Direct radiation is used in the main entrance lobby and entrances on the sides of the building, and is supplied by re-circulating air warming units. Stores, offices, corridors, stairways, et cetera, are served by direct radiation. Six vacuum pumps are provided for maintaining the required vacuum in the heating returns and for the disposal of air and condensation. Automatic control is provided to regulate temperature throughout the building.

Thirty-one motor-driven fans with a capacity of 1600 tons of air per hour are provided for ventilation. Seventy-five vent fans, capable of discharging 2900 tons of air per hour, are distributed throughout the building. Of the air supplied to the building, 72 percent is for the main hall.

Due to the fact that the building is to be used not only for conventions of various kinds, but also for machinery exhibitions, it was necessary to install elevators capable of handling various types of heavy equipment. Also since one end of the building is almost entirely devoted to the stage and its various dressing rooms, it was necessary to provide several elevators to handle the huge numbers of chairs and the stage scenery. After making a careful analysis, Otis elevators were selected to be installed throughout.

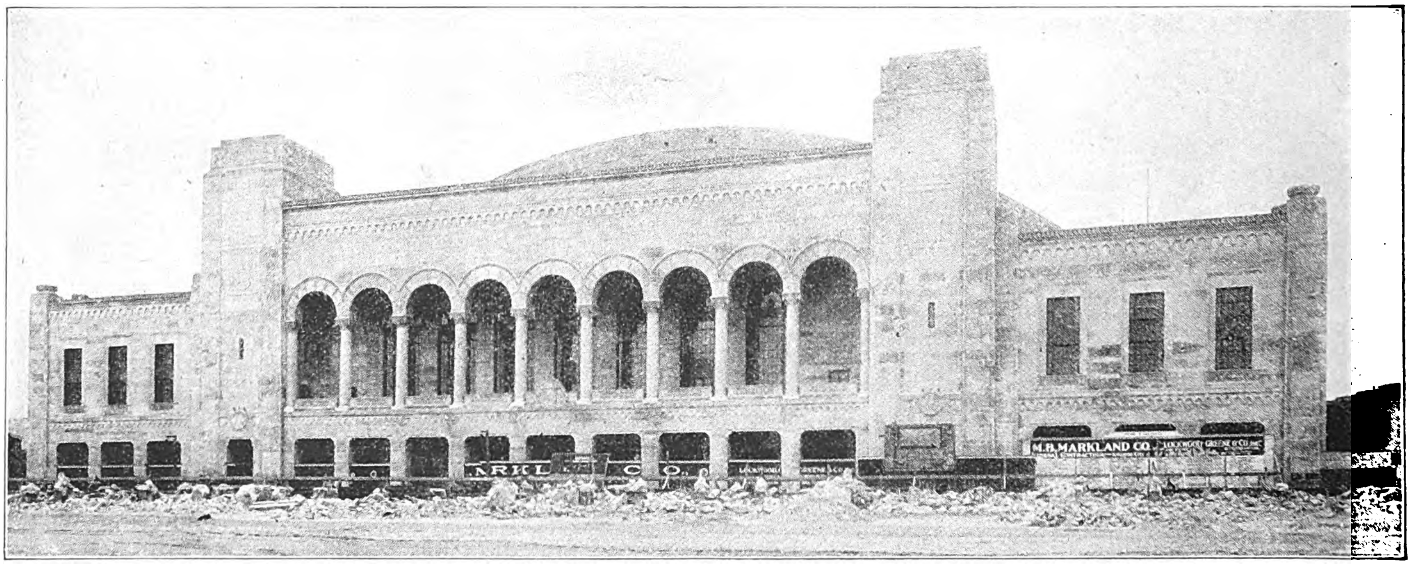


GEORGIA AVENUE SIDE

This view was taken on the board-walk looking back toward the auditorium stage showing steps, ramp, and entrance doors

The equipment consists of two large freight elevators of the vertical steel screw type, each having a capacity of 50,000 pounds. A separate freight elevator having a capacity of 4000 pounds is provided for handling trunks and other freight, these elevators being provided with power-operated doors. A specially designed organ lift will raise and lower the two organ consoles from the orchestra pit to the stage level. There will also be a passenger elevator having a duty of 2000 tons.

The work on this building was started under the administration of Mayor Edward L. Bader and was in the direct charge of Commissioner Harry T. Headley. The architects are Lockwood-Greene and Company Inc., with Cook and Blount as associate architects. The associate engineer was Mr. Alexander H. Nelson of Atlantic City and the M. B. Markland Company were general contractors for the foundations and superstructure of the building.

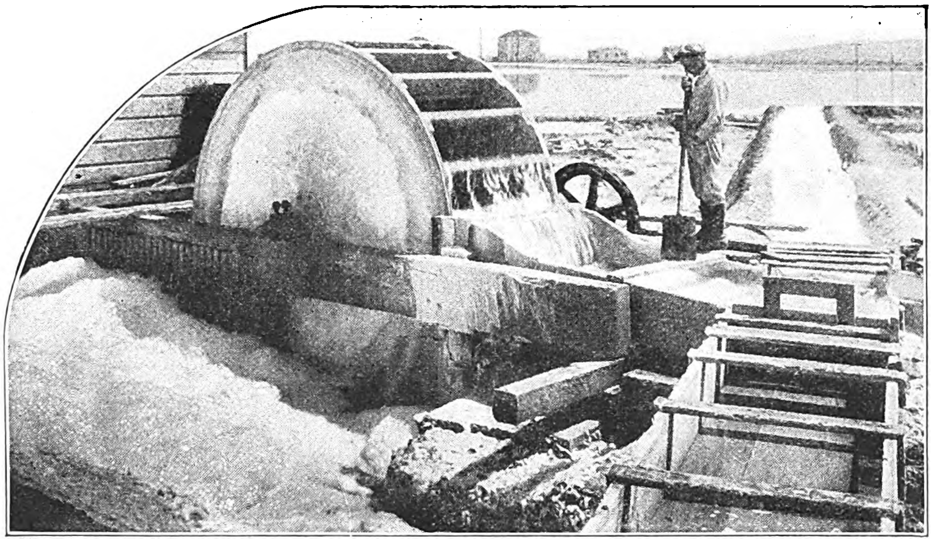


AS THE CONVENTION HALL APPEARED IN NOVEMBER

On the left tower of this imposing structure appear, carved in the stone, the words "Festivities, Music, Pageantry, Drama, Athletics"; on the right, "Education, Science, Conventions, Art, Industry." In the center, an inscription sets forth the ideals that inspired it

Salt from the Sea

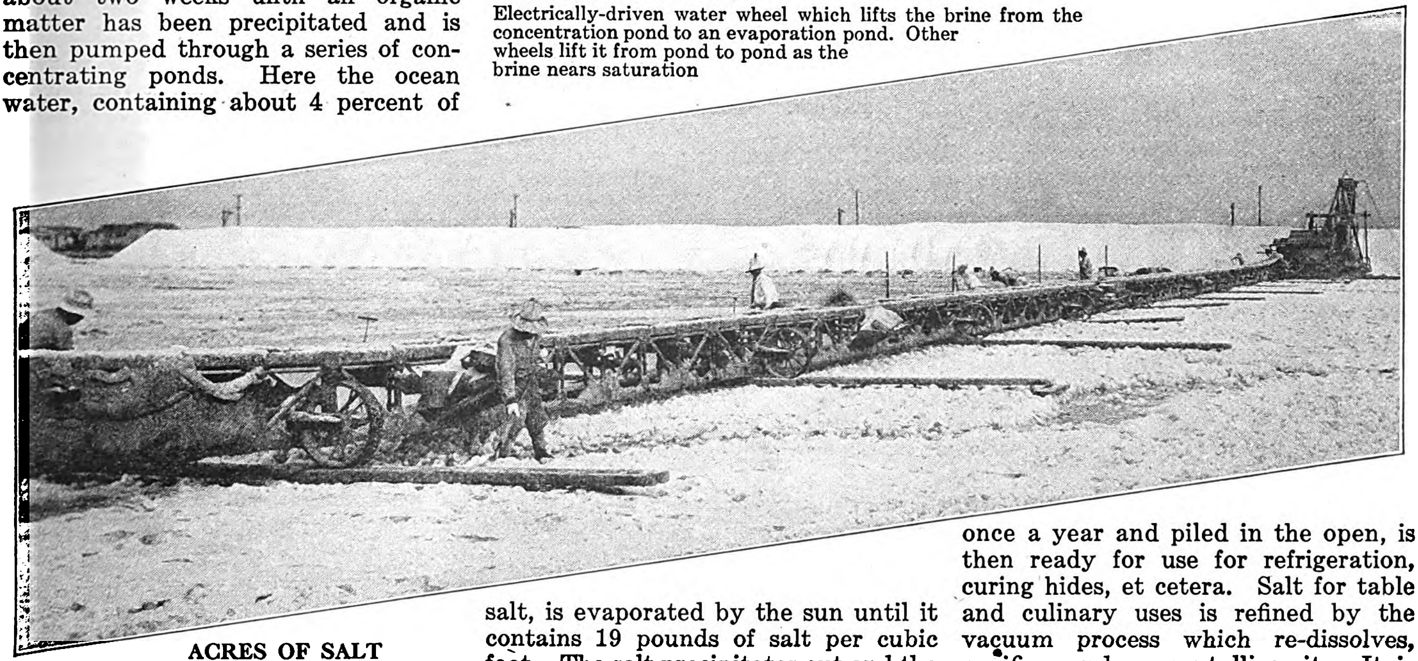
CALIFORNIA'S hot sun is good for something besides making a delightful climate; it is put to work reclaiming salt from ocean water. To the south of San Francisco, on the Oakland side of the bay, is the plant which utilizes solar heat for the evaporation process. At this plant, concentration ponds and harvesting fields occupy 15,000 acres. About once a month during the salt-producing season from May to October, ocean water enters a large intake pond. The water is allowed to stand in this pond about two weeks until all organic matter has been precipitated and is then pumped through a series of concentrating ponds. Here the ocean water, containing about 4 percent of salt, is evaporated by the sun until it contains 19 pounds of salt per cubic foot. The salt precipitates out and the remaining liquor is pumped back into the bay. The crude salt, harvested once a year and piled in the open, is then ready for use for refrigeration, curing hides, et cetera. Salt for table and culinary uses is refined by the vacuum process which re-dissolves, purifies, and re-crystallizes it. It is then conveyed to screens where it is graded ready for packing.



Photographs courtesy Californians, Inc

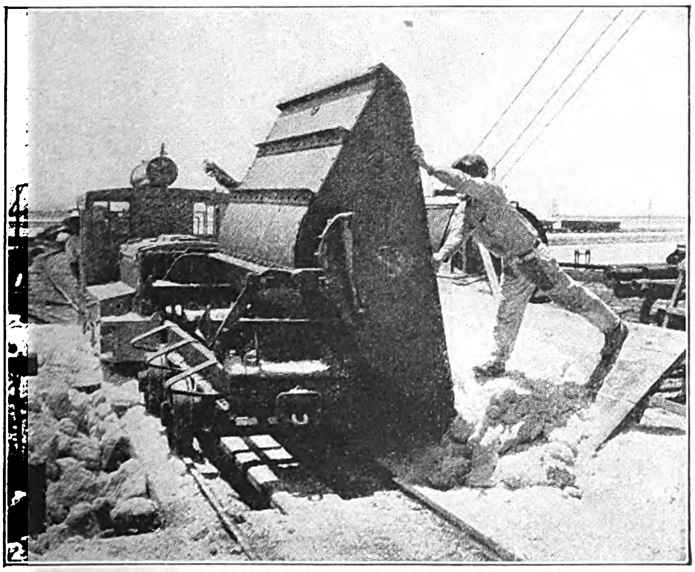
FROM ONE POND TO ANOTHER

Electrically-driven water wheel which lifts the brine from the concentration pond to an evaporation pond. Other wheels lift it from pond to pond as the brine nears saturation



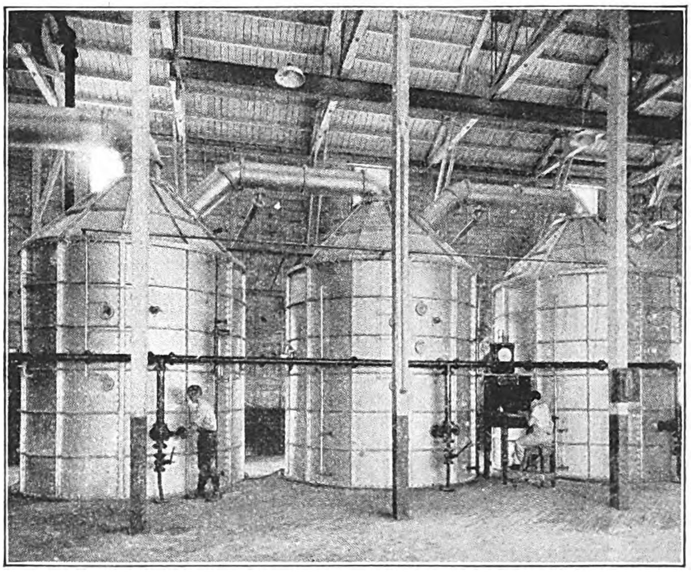
ACRES OF SALT

Harvesting crystallized salt. By this method, it is lifted by hand to conveying belts which carry it to the washer and piler



INTO ONE OF THE REFINERY PITS

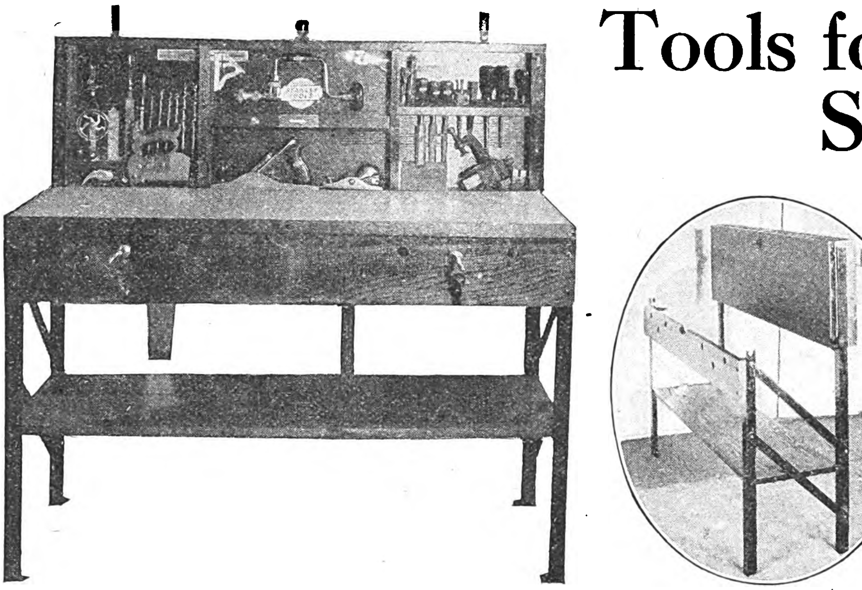
Thousands of tons of crude salt are brought to the refinery in trains of dump cars by a small gasoline engine and dumped into pits



VACUUM PANS FOR THE REFINING PROCESS

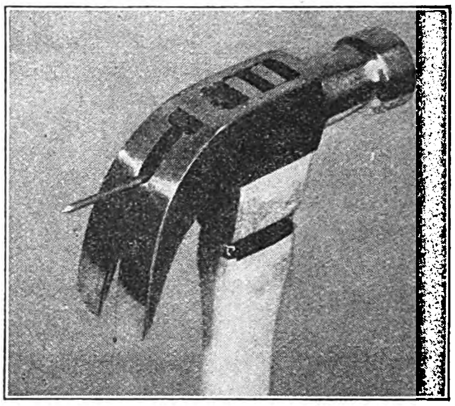
Obtained in its crude state by the ancient method of evaporation. the salt is then refined by a modern process, ready for table use

Tools for the Shop and Home



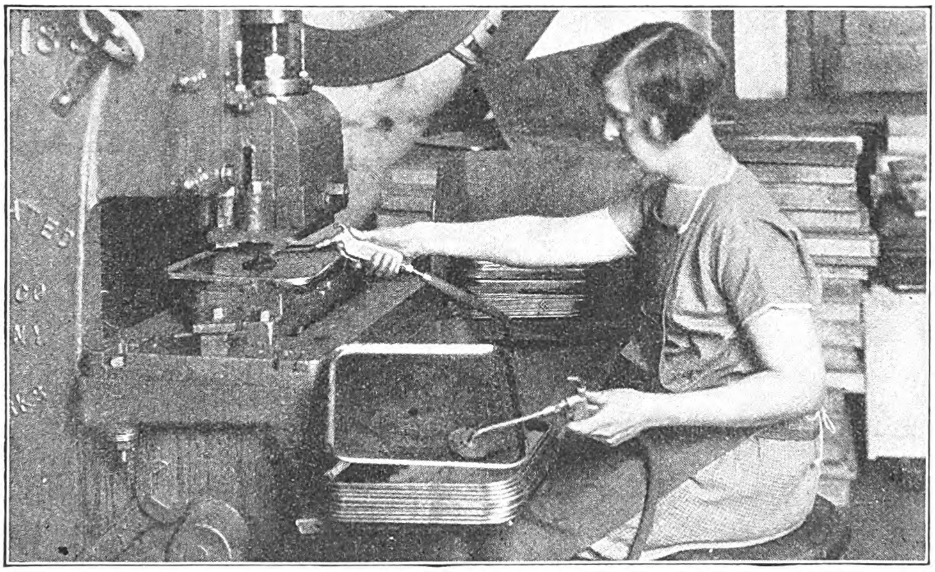
WORK BENCH HAS BUILT-IN TOOL CHEST

Supported by steel legs, this bench contains its own tool chest and has a wide working surface that folds back to encase the tools when not in use. The wooden parts of the bench are of spruce, stained inside and out. Among the 35 household tools included in the set are screw drivers, rules, pliers, chisels, bench brackets, saw, brace and bits, hammer, vise, pipe wrench, block plane, jack plane, and bench dog. The top of the bench is 33 inches from the floor and is 48 inches long by 16 inches wide.—*The Stanley Rule and Level Plant, The Stanley Works, New Britain, Conn.*



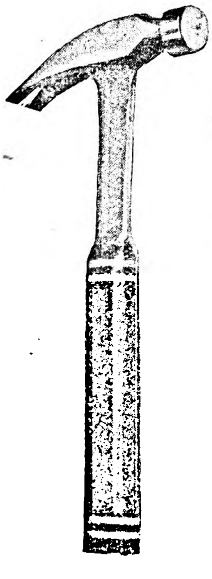
NAIL STARTER

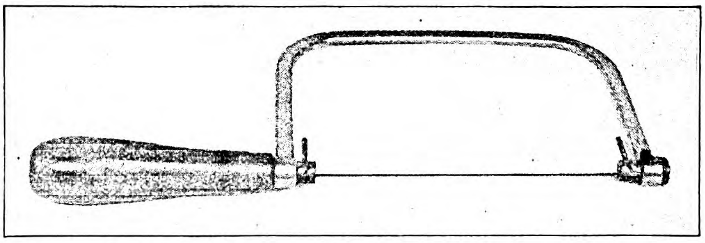
Fewer injured thumbs will result from the use of this hammer, in which the nail is placed in the groove and started with a lusty blow. Otherwise built like a regular hammer, this tool will be appreciated where one hand must be left free to do other work.—*Hammacher, Schlemmer and Company, 133 Fourth Ave., N. Y.*



◄ **PRESS FEEDER**

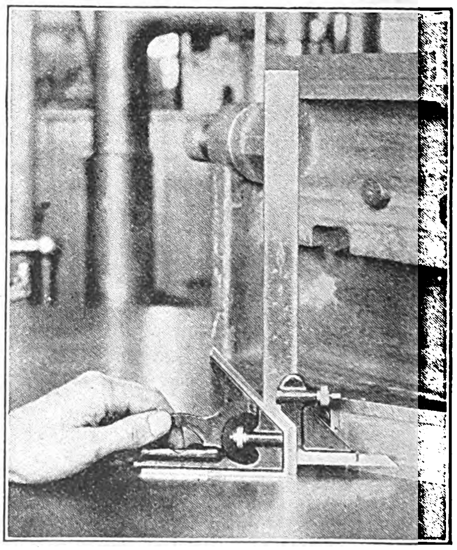
Feeding punch presses becomes less dangerous to the operator, and the rate of production is materially increased, by using these pneumatic "guns." As the air passes through the gun a vacuum picks up the object, exerting a force of about 12 pounds. The suction is released by a hand trigger.—*Michigan Metal Products Co., Battle Creek, Mich.*





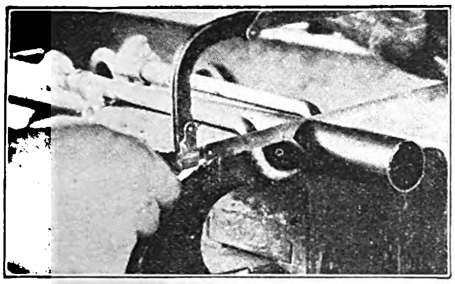
◄▲ **ONE-PIECE HAMMER: NEW SAW BLADE**

At the left: Head and shaft of this hammer are cast in one piece of metal, eliminating the danger and loss of time resulting from the head flying off or coming loose. The handle is made of laminated leather, compressed and ground to shape. The one-piece design of the head and shaft also increases the driving power of the hammer, and improves the balance. *Above:* The blade of this saw is made of specially processed steel, set to saw through any material without the necessity of changing the blade. It cuts through fiber-board, wood, Bakelite, bone, metal, and other materials. Both of these tools may be obtained from *Hammacher, Schlemmer and Company, 133 Fourth Avenue, New York*



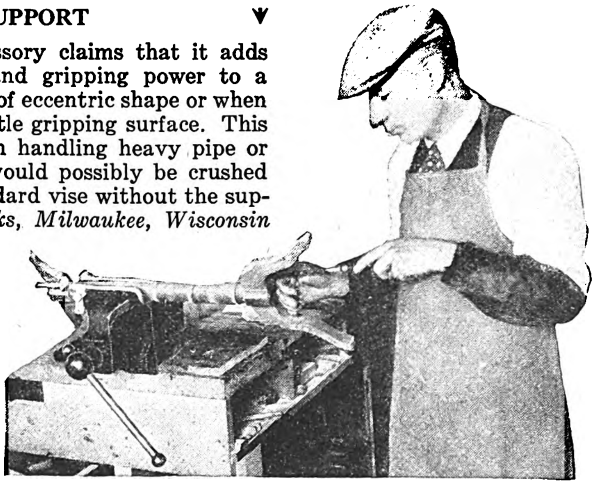
HEIGHT GAGE

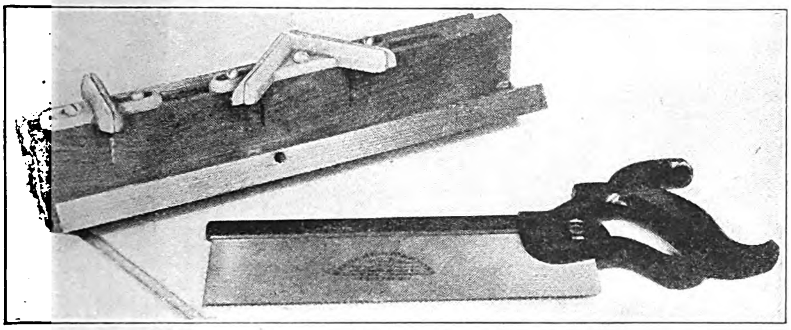
When used on the blade of the combination square this attachment makes the instrument a height gage. Users of combination squares or sets will find this device particularly useful for making comparative measurements and in finding heights of projections from plane surfaces.—*Brown and Sharpe Manufacturing Company, Providence, Rhode Island*



RIGID VISE SUPPORT

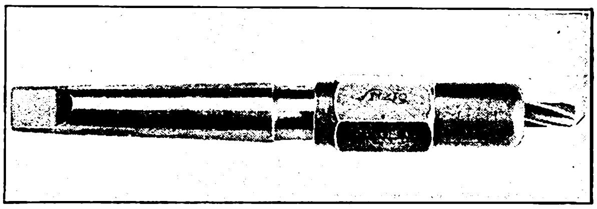
The manufacturer of this accessory claims that it adds practically unlimited holding and gripping power to a standard vise, especially on jobs of eccentric shape or when working with stock with very little gripping surface. This support is of particular value in handling heavy pipe or tubing and other objects that would possibly be crushed if they were to be held in a standard vise without the support.—*A. F. K. Fountain Works, Milwaukee, Wisconsin*





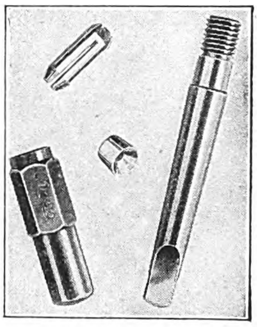
COLLAPSIBLE MITER BOX

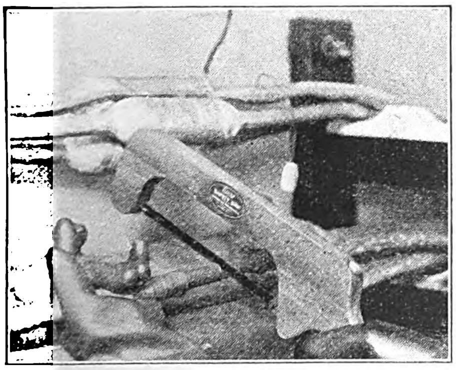
Supplanting the usual bulky miter box of the carpenter shop, this improved device can be folded compactly to fit into a portable tool chest. The adjustable metal guides make it less difficult to turn out neat and accurate work, with a minimum of wasted time and material. When opened and ready for business, the box is made rigid by placing the steel pin through the hole in the base. Despite its convenient size and light weight, this collapsible miter box is solidly constructed and will stand exceedingly hard usage.—*Hammacher, Schlemmer and Company, 133 Fourth Avenue, New York City*



DRILL CHUCK

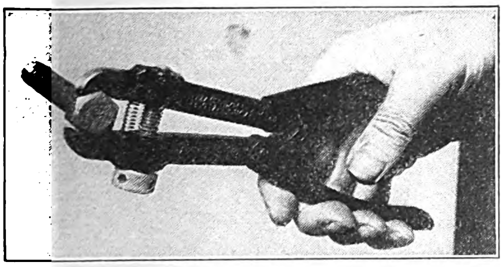
An improved drill chuck with drill in place, and some of its parts, designed to reduce vibration and the resulting breakage bills by providing the smallest possible projection of the twist drill. Another feature is that this chuck uses either double twist or standard drills—*Specialty Trading Corporation, 561 Fifth Ave., N. Y. C.*





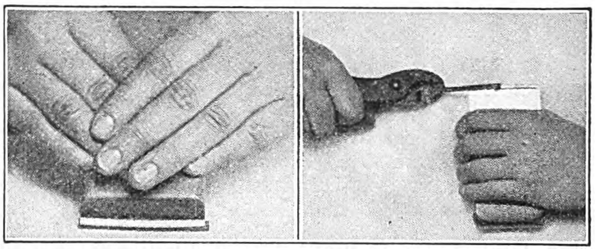
HACKSAW

In cutting metal conduits or on other hacksaw jobs where there is possible danger from electric currents, this wooden handled hacksaw will be welcomed. The grip is built of seasoned hard wood and is shaped to fit the hand. Like other hacksaws, this safety saw uses standard blades which can be put in or removed without difficulty.—*Engineering Products Co., 25 Church Street, N. Y. C.*



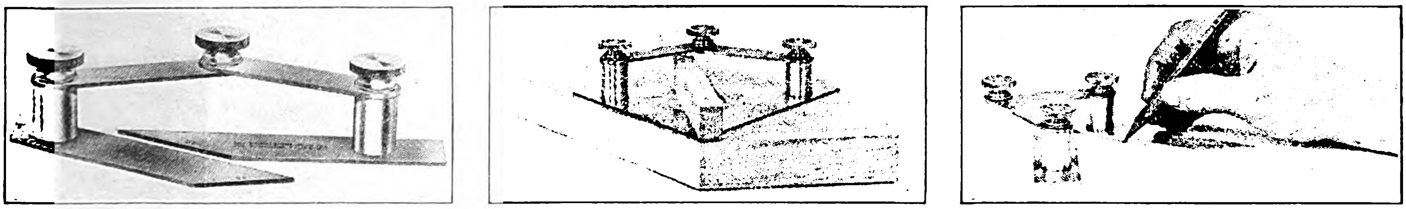
LIKE A VISE

This new tool operates like pliers and grips like a vise. Its compound leverage delivers a one-ton grip at the jaws, which fit round, square, or hexagon objects. The screw locks the jaws to any object.—*The Lawson Manufacturing Company, 2720 E. 53rd Street, Cleveland, O.*



HOOK SCRAPER

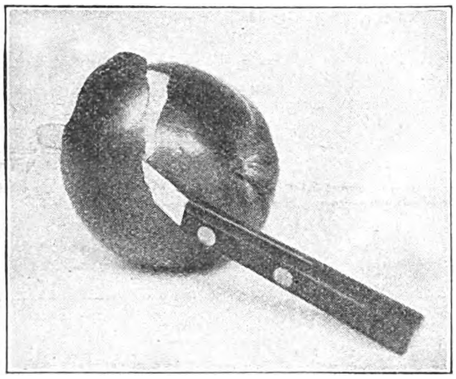
To meet the demand for a hand scraper with a cutting edge capable of cutting real chips, this new tool has been designed and patented. The hook scraper pulls toward the operator, and for fast scraping is held nearly perpendicular to the surface. For fine scraping it is held almost flat. The cutting edge can be extracted and re-sharpened.—*Hook Scraper Company, 96-85 219th Street, Queens, New York*



VERSATILE COMBINATION BEVEL

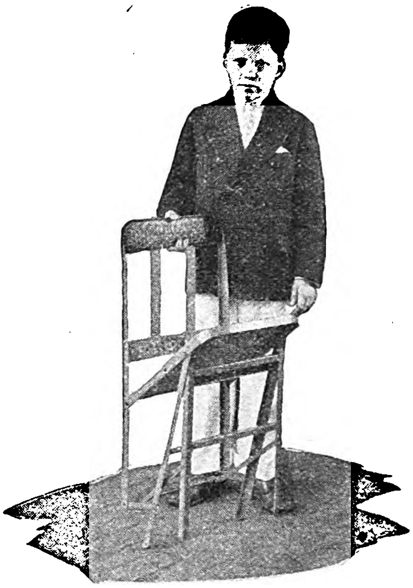
An unusually large number of combinations are obtainable with this instrument, and in every setting there is complete visibility of the angle. The blades can be set at any angle, and the height of the posts permits easy reading of the arc, as well as providing clearance for drawing or scribing lines the full length of the blades. The blades are of steel, ground on all sides and on their ends. To decrease the weight of the instrument, the posts are made of a light metal. An almost unlimited variety of combinations can be arranged without difficulty by using this instrument. By means of the clamp nuts, the blades can be either moved freely or securely locked.—*Brown and Sharpe Manufacturing Company, Providence R. I.*

Household Inventions



PARING HOOK

The curved blade of this knife helps to speed up peeling jobs. The tip of the blade is curved also, for removing eyes and spots.—*Burns Manufacturing Co., Syracuse, New York*

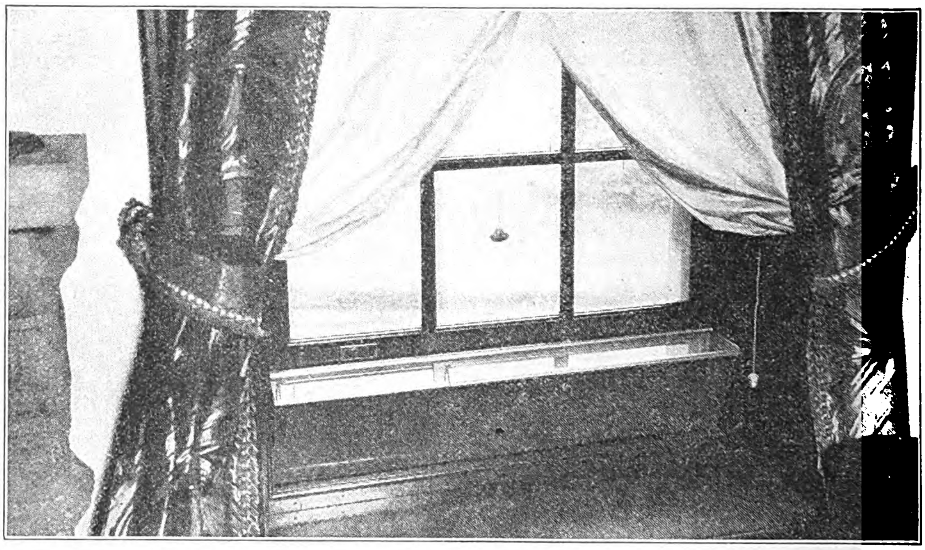


< ▲ IMPROVED CHAIR

The lowly folding chair now appears in fancy dress. The latest model is made of steel, with leatherette seat and back, and is painted in a wide variety of colors. Each chair weighs approximately nine pounds.—*One-Flip Folding Chair Company, 1644 American Furniture Mart, Chicago, Illinois*

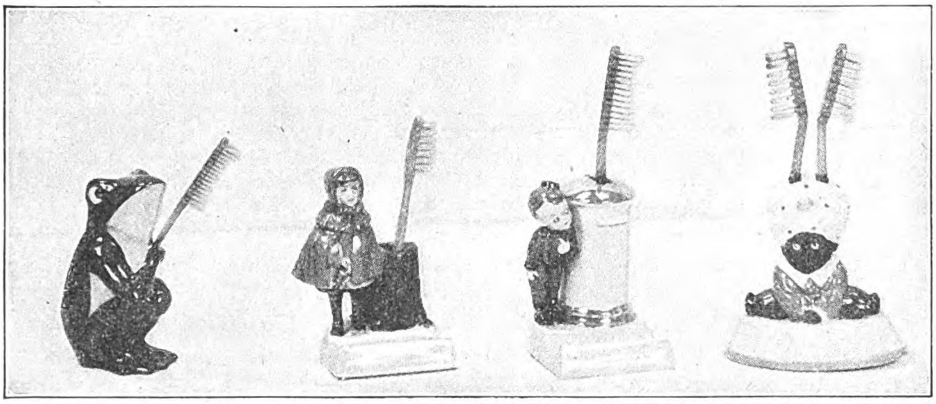
FLOWER HOLDER

A practical device for displaying short-stemmed cut flowers has long been sought. A flexible ring made of plated brass, that fits around the inner edge of a small bowl of any shape, holds such flowers in place very effectively. —*Mima K. Finlayson, 2125 Hillcrest Drive, Los Angeles, California*



SCREEN VENTILATOR

This adjustable ventilator is made to fit any window, acting as a screen as well as a draft guard. Built of heavy metal, with copper screening, it protects curtains from dust and rain.—*Hudson Superior Screen Ventilator Company, Inc., Real Estate Trust Building, Philadelphia, Pennsylvania*

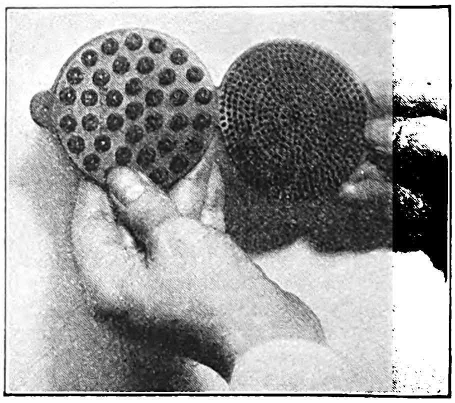


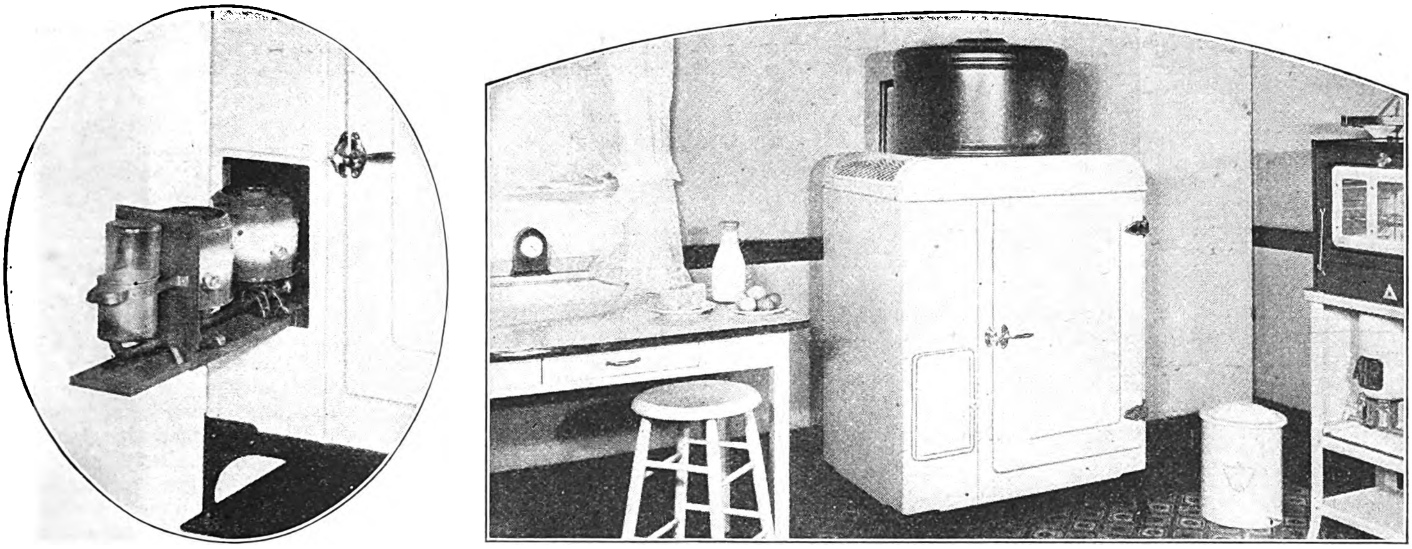
▲ TOOTHBRUSH HOLDERS

Little children will not regard brushing their teeth an unpleasant task if their toothbrushes are held, when not in use, by one of these imported holders. These holders are made in a wide variety of shapes and colors, and are designed to appeal to children of all ages.—*Meyer and Lorang, 130 West 42nd Street, New York City*

HAND MASSAGE >

Two sizes of rubber projections, the larger size containing vacuum cups, are provided on this little device which simplifies massaging. When in use, it is buttoned to slip over the fingers, enabling the manipulator to hold it firmly while it is being used, and quickly to change the face when desired.— *F. W. Woolworth Stores*





AUTOMATIC REFRIGERATORS NOW OPERATED BY KEROSENE BURNERS

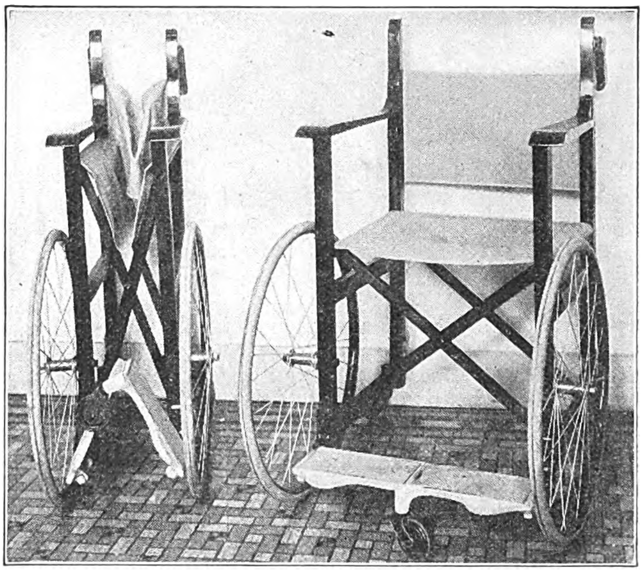
To meet the demand for a modern refrigerator that will work anywhere, a new type home refrigeration plant has been perfected. Powered by the heat from a kerosene burner, this refrigerator operates automatically, silently, and requires no servicing. In appearance it compares favorably with modern gas and electric refrigerators, and can be used where other fuels are not obtainable. The cooling liquid is hermetically sealed in the refrigerator, which operates on the familiar principle of absorption. All the user has to do is to regulate the oil burner. Without inconvenience and at a cost of as little as two cents a day, residents of rural regions may now enjoy foods and drinks that can be kept pure and appetizing only with modern refrigeration. The model shown has about five cubic feet of food space.—*Perfection Stove Co., Cleveland, O.*

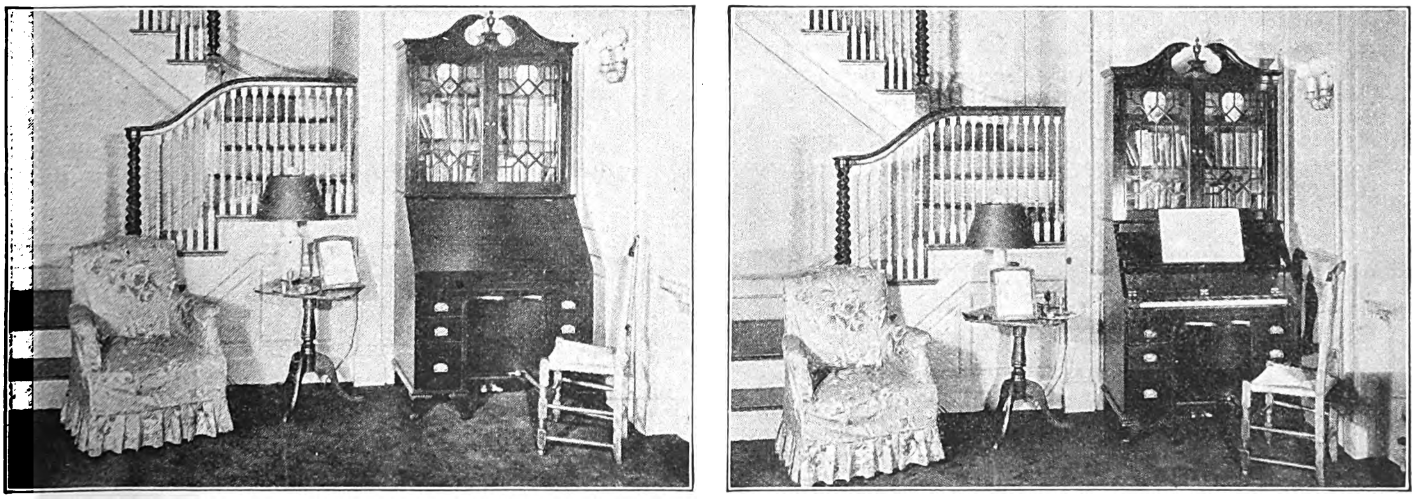
◄ SEWING BASKET

This work basket is ornamental as well as useful, and makes it possible to find the proper sewing articles at a moment's notice. The basket is eight inches in diameter and four inches high, with sidewalls of cretonne. —*Massillon Wire Basket Company, Massillon, Ohio*

WHEEL CHAIR ►

When not in use, this wheel chair can be closed up like an accordion and placed out of the way. The chair is equipped with rubber tires, and is designed for the support and comfort of its user. —*Torrington Specialty Company, Torrington, Connecticut*





COMBINATION WRITING DESK AND PIANO

The designer of this quaint but handsomely built piece of furniture suggests that the lower compartment of the book-case would be an ideal place for the radio set. The entire combination would then include radio, book-case, writing desk, and piano. From the design and construction, one might presume it to be the product of an early American craftsman. Although the piano is small, its tone is said to be excellent.—*Piano Crafter's Guild, 82 Brown Place, N.Y.C.*

The Scientific American Digest

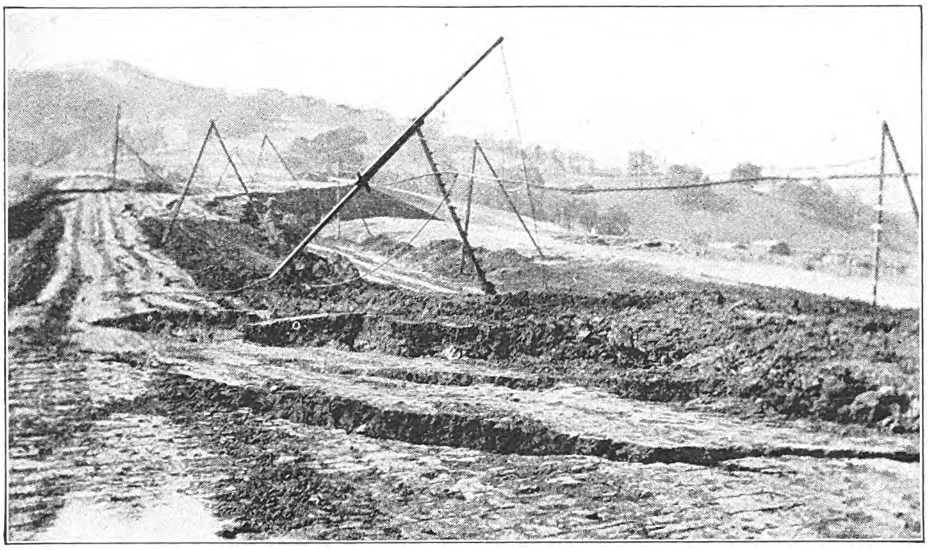
A Review of the Newest Developments in Science, Industry and Engineering

Lafayette Dam Failure

WHEN the Lafayette earth fill dam, which is part of the Mokelumne Project in California described in SCIENTIFIC AMERICAN for December, 1928, was about 90 percent complete, it failed partially by the slippage of a great area on the downstream slope. Cracks began to appear on that slope and a gradual settlement of the center, principally downstream, continued so that in a short time an area of almost 500 square feet had sunk approximately 20 feet.

At the time of the settlement, there was but 15 feet of water behind the unfinished dam and no water damage was done. Had there been water behind the dam, it is possible that a devastating flood similar to that let loose when the St. Francis Dam failed, might have rushed through the valley below the dam.

The cracks in the Lafayette Dam showed a dry, homogeneous, and well-compacted fill. Therefore the failure cannot be attributed to methods of construction, nor probably to the design, since the dam has a conservative section. At the time this is written, engineers had not been able to state the cause of the settlement. To all appearances, however, and taking into consideration the known facts, it has been suggested that the foundation material in the stream-bed area beneath the dam lacked sufficient stability to support the weight of the dam. The sandy clay, possibly of a semi-fluid nature, was compressed—and perhaps continues to be compressed—by the great weight, and some of it was pushed out downstream and probably to a lesser extent upstream.


A general view of the great area, on the downstream slope of the Lafayette Dam, which failed by slipping, or caving in, when the dam was almost complete

The 1928 West Indies Storm

ABOUT 1000 miles southeast of the eastern islands of the Caribbean Sea and 10 degrees north of the equator is an extensive area in which, in the latter part of the northern summer, the air moves slowly northwestward and in which local disturbances produce variable breezes which often result in a circular motion. All circular air near the earth's surface is in a counter-clockwise direction, if it is located anywhere north of the equator.

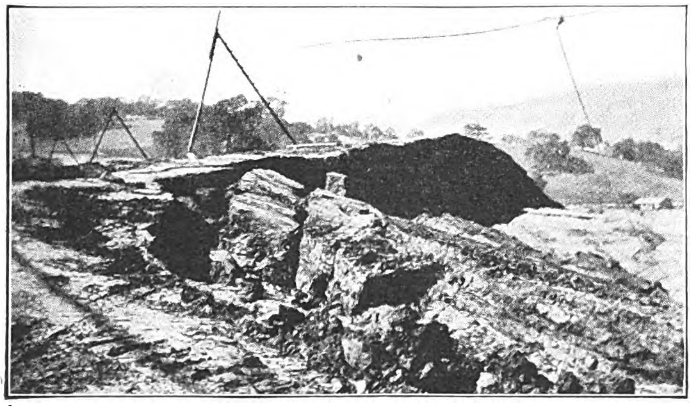
Sometime during the latter part of the first week of September, 1928, some variable breezes threw themselves into a circular motion or whirlwind which grew in size and circular speed, passed the tornado stage and became sufficiently large to be called a hurricane by the time it struck the French and British isles of Martinique and Dominica respectively, where much damage was done.

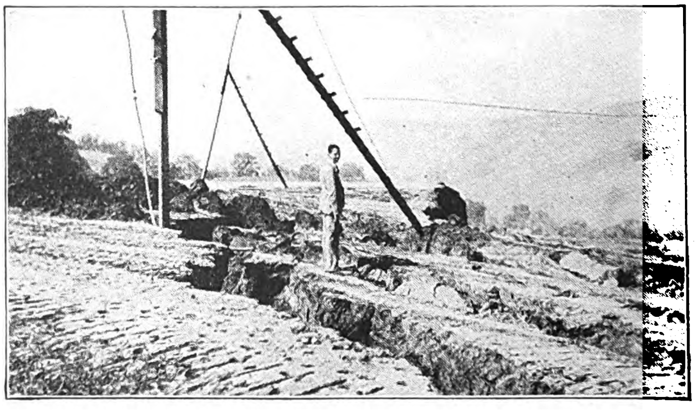
On the 12th and 13th it passed over Porto Rico, leaving great damage in its wake. It continued in its northwestward path, at the rate of 300 miles per day, passing over the Bahama Islands, and on Sunday, September 16, arrived at the Florida shore with its center at Lake Worth, a few miles south of Palm Beach. The reported time for the calm center to pass was from 4:00 to 6:30 P.M. Sunday. The estimated speed of the circular wind about the center was 150 miles per hour at maximum. The lowest barometer reading reported was 28.10.

The storm center then moved across Florida along a line joining the following towns,—Lake Worth, Canal Point, Sebring, Bartow, Lakeland, Brooksville, Tyler, White Springs, thence northeastward by Waycross, Ga., near Augusta, Ga., Columbia, South Carolina, Virginia Capes, Delaware Capes, and New Jersey coast.

The highest speed of the wind reported inland away from the coast was 75 to 80 miles per hour. By the time the storm center moved from Lake Worth to near Lakeland the speed was reduced from 150 to 75 miles per hour. Also no calm center was reported from any place after it left Lake Worth. The reduced speed, and trees and buildings caused the center to be broken and hence not so noticeable.

The energy which caused this storm and others to develop from a whirlwind into a hurricane, was supplied by the rapid condensation of the water vapor in and about the center of the rapidly rising air which was being pushed up by the cooler air flowing in from the north side. This energy and the size of the whirling storm continued to increase while it was traveling mostly over water. On this account the circular speed was at its maximum when


Close-up view of the "crest" from which point the earth of the dam pulled away. Note compactness of the soil


Another view to show comparative size of cracks in the dam. Marks in the foreground were left by tampers

it reached the Florida coast, at which place the calm center was about 30 miles in diameter. This calm center was caused by the centrifugal force of the wind about the center. This force was also equaled by the pressure of the outer air moving towards the center. The difference between the pressure at the center and the outer parts of the hurricane was about one pound per square inch or 3000 tons per acre or 2,000,000 tons per square mile when it hit the Florida coast.

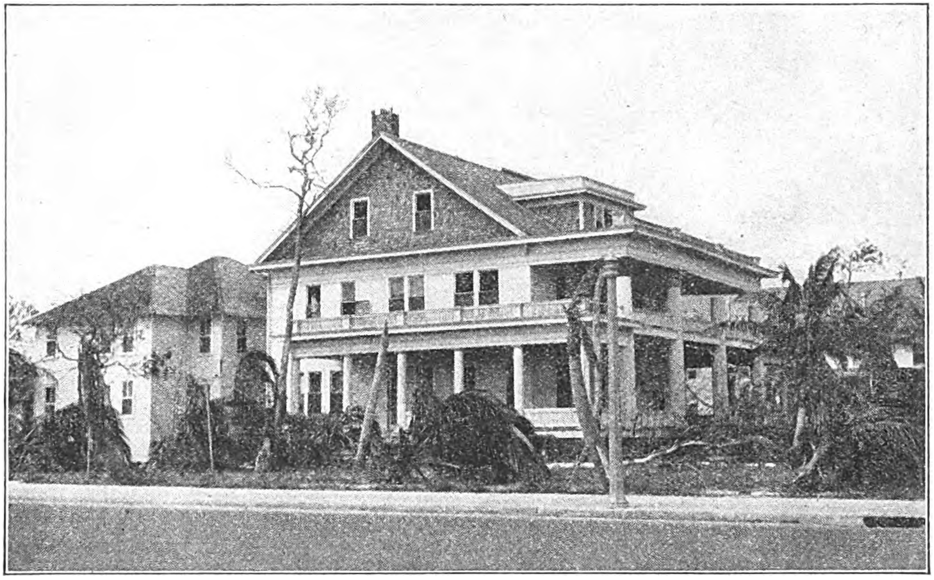
As the huricane moved over Florida, part of the water vapor supply was cut off and so its circular speed was reduced. Trees, buildings, and small hills also had their checking and diverting effect so that no serious damage was done after it got well inland. The hurricane while over Florida was more than 1000 miles in diameter.

In Winter Park, Florida, the first hurricane winds were mild breezes from the northeast and they started on Saturday, September 15th. The wind was not constant but variable. During the worst part it would range from 30 to 75 miles per hour in a minute's time as indicated by the barometer reading at 3:55 A.M. September 17, when the barometer would change .02 inches in a minute.

It began to rain in Winter Park when the wind had changed to almost east and continued with intermittent showers until the wind shifted to the southwest at which time the storm center was northwest.

The temperature during the storm varied from 73 degrees to 77 degrees, Fahrenheit. Total rain in Winter Park was 3.75 inches.

The conclusion to be drawn from this study, according to Professor Lewis Elhuff, of Winter Park, is that, in the interior of Florida, houses and buildings should be erected to stand a wind of 80 to 90 miles per hour, while on the east and west coast of Florida they should be erected to stand a wind of 150 miles per hour, in order to avoid damages by hurricanes such as the one described above.


A freak of the West Indies storm. While the house was not demolished, the capitals on three of the columns were crushed by the downward force of wind

Radio Soprano Correction

IN connection with the article entitled "Why is a Radio Soprano Unpopular," which appeared in our October, 1928, issue, we published a chart of the musical scale which aided in illustrating graphically the reasons why a radio soprano is unpopular. The author of this article supplied us with the material for this chart, which was re-drawn by our artist.

It has now come to our attention that this chart was originally copyrighted by the National Association of Musical Instrument and Accessory Manufacturers. We are pleased to give credit here to the association for the preparation of this chart in its original form.

World's Best Collection of Rare Gases

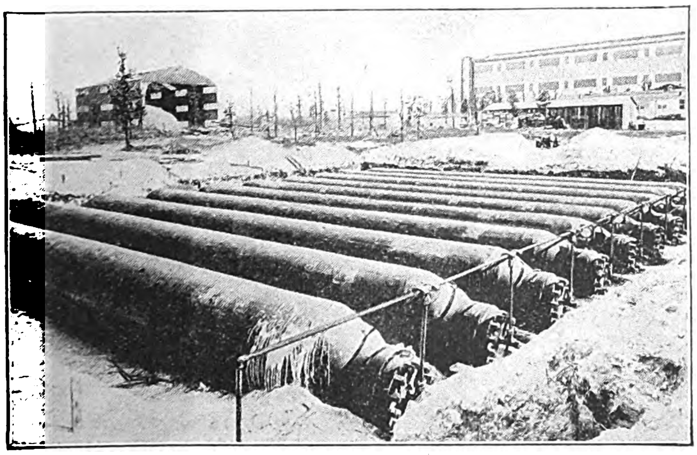
MANY years spent in the study of gases, which have resulted in the accumulation of the best collection of rare gases in the world, is, in a sentence, the interesting career of Dean R. B. Moore of the School of Science and head of the Department of Chemistry at Purdue University, Lafayette, Indiana. Although there may possibly be someone in a foreign country who now has more rare gases, two years ago he obtained evidence that he had the only krypton and xenon in the United States, and the only pure samples in the world. So far as he knows, this fact is true at the present date.

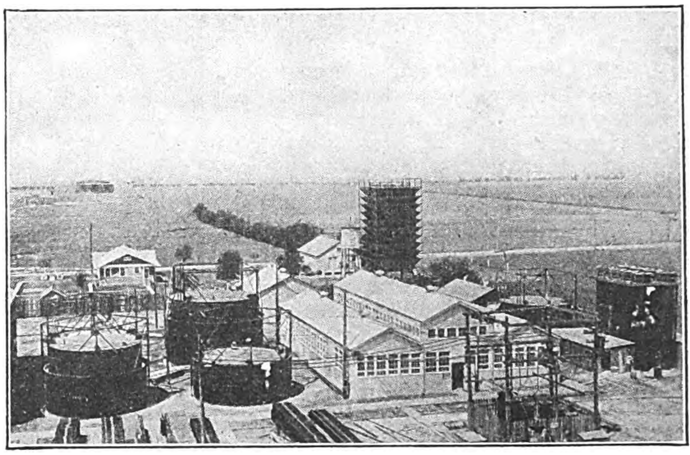
Doubtless it has never occurred to you that when you take a breath, you inhale a bit of neon, argon, krypton, and xenon. These are four of the five really rare gases. Helium is the fifth.

Had it not been that these gases must be isolated from all foreign matter before they are of any use whatsoever, Dean Moore and many other scientists would have had an easy job of it. As it is, krypton and xenon are in our atmosphere only in the proportion of one part in 19,000,000 and one part in 190,000,000, respectively. Neon is a part of the air in the proportion of one to 55,000. Argon, forms about nine tenths of one percent of the atmosphere and at the present time is used extensively as a filler for electric light bulbs. All of these gases are chemically inert, have no color, smell, or taste, and are relatively hard to isolate—especially krypton and xenon.

Two little glass tubes which Dean Moore estimates are worth several hundred dollars each, contain what is probably every bit of perfectly pure krypton and xenon that exists. They look absolutely empty and useless but the careful handling which these tubes receive when the Dean exhibits them gives a slight impression of how highly they are valued by the man whom many writers have called the foremost authority on rare gases today. No practical use has as yet been found for them, therefore the samples have no intrinsic value.

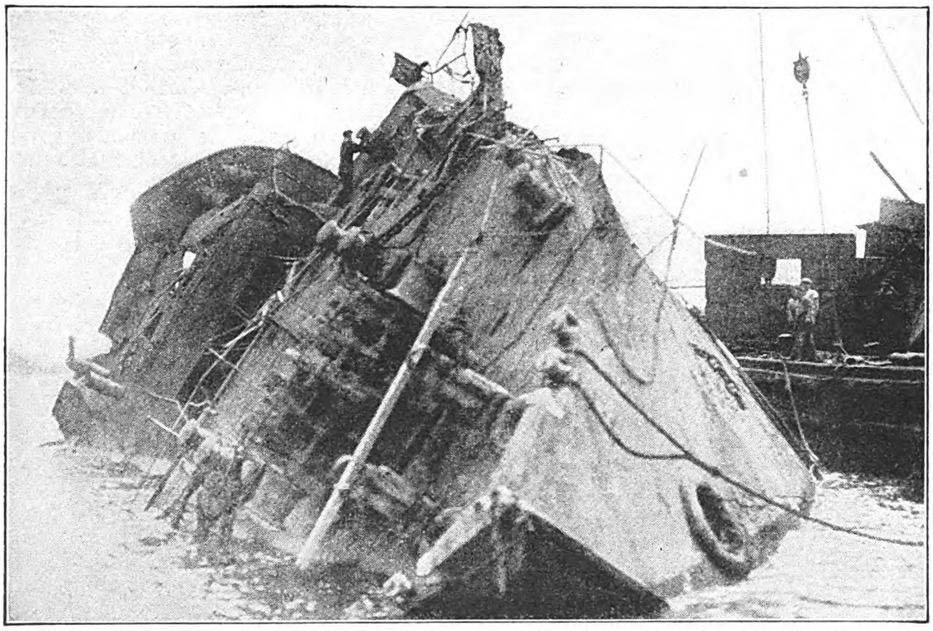
"I made my collection," said Dean Moore, "during the time I was working with Sir William Ramsay about 1909, and also more recently in connection with the commercial production of helium. The tremendous strides made in helium


High pressure storage at the Naval Air Station at Lakehurst. Each cylinder holds 50,000 cubic feet of helium


The plant in Texas where helium is extracted from natural gases for use in the government's dirigibles

production since the war have made it a relatively common gas, and its use in airships has started a series of investigations which rob it of a good deal of its former mystery. Only yesterday, a cylinder of helium came in from the government plant in Texas, containing about 160 cubic feet—more helium than there was in the whole world before the World War. Helium can hardly be considered rare any more, and the other four gases, neon, argon, krypton, and xenon, are becoming better known every day.

"In a laboratory upstairs," continued Dr. Moore, "we are endeavoring to procure additional samples of xenon and krypton. Some time ago we received a cylinder of oxygen residues, rich in krypton and xenon, but it is a very slow process to procure these gases in pure samples."



When the Norwegian freighter, *Bessegen*, sank in New York harbor after being hit by a liner, it became a menace to navigation and had to be removed

Rubberized Violins Rival Old Masters

MODERN violins may be made to rival the product of the old masters by impregnating the wood with rubber latex before varnishing, according to the claim of a German investigator named Ditmar-Graz, writing in the scientific magazine *Natur und Kultur*. He states that this treatment causes the wood to remain permanently elastic.—*Science Service.*

Removing a Wreck from New York Harbor

A HUGE steel fragment of nearly 500 tons, the bow of the wrecked Norwegian freighter *Bessegen*, held the record for all time of weights lifted by floating derricks until it was eclipsed, a short time later, by a second section of the same ship, both raised recently by the Merritt-Chapman and Scott Corporation's floating derricks *Monarch* and *Conveyor*.

The *Bessegen*, a tramp steamer of 1900 tons, for more than a year has rested on the bottom of New York Harbor's "Upper Bay" where, at anchor one foggy night, it was rammed by an outbound liner and sank like a shot. Its cargo of sugar, of course, was a total loss, soon melting away to sweeten the waters of the bay. The hull, likewise damaged beyond profitable recovery, was classified as a "menace to navigation" by the United States Army Engineer Corps and now is being broken up and removed by the salvage company.

The unique plan of removing the whole ship in only four gigantic "bites," instead of many smaller ones, is made advisable by the hulk's position in one of the busy spots of the world's water traffic; such a plan is made possible by the vast power of the two super-derricks that are being used.

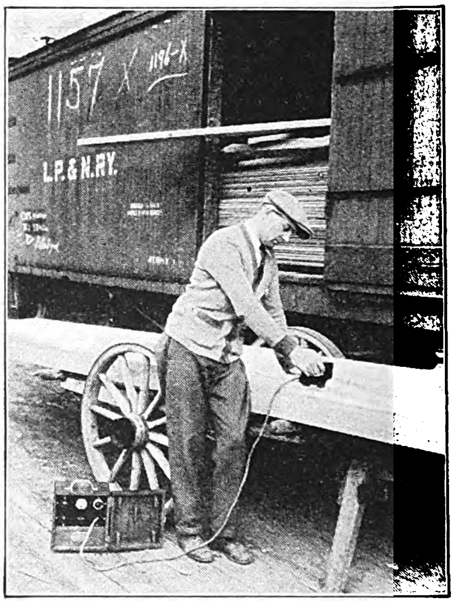
The *Monarch* is the newest and finest as well as the most powerful salvage derrick ever built. Its hull is of patented steel construction, built to withstand tremendous stress and strain. It is capable of lifting 300 tons over-side and has a specially designed water-ballasting system to counteract its list when hoisting and tending to keep it on an even keel. Its companion derrick, the *Conveyor*, was especially developed for this job and is almost as powerful as the *Monarch*.

Work of dismembering the hulk is done by means of dynamite, the "salvage-man's hacksaw," accurately placed in position by divers. Before the third section is raised, vital parts of the ship's machinery will be separately removed, probably little damaged by the blasts except in the case of cast iron parts such as bed plates, frames, et cetera.

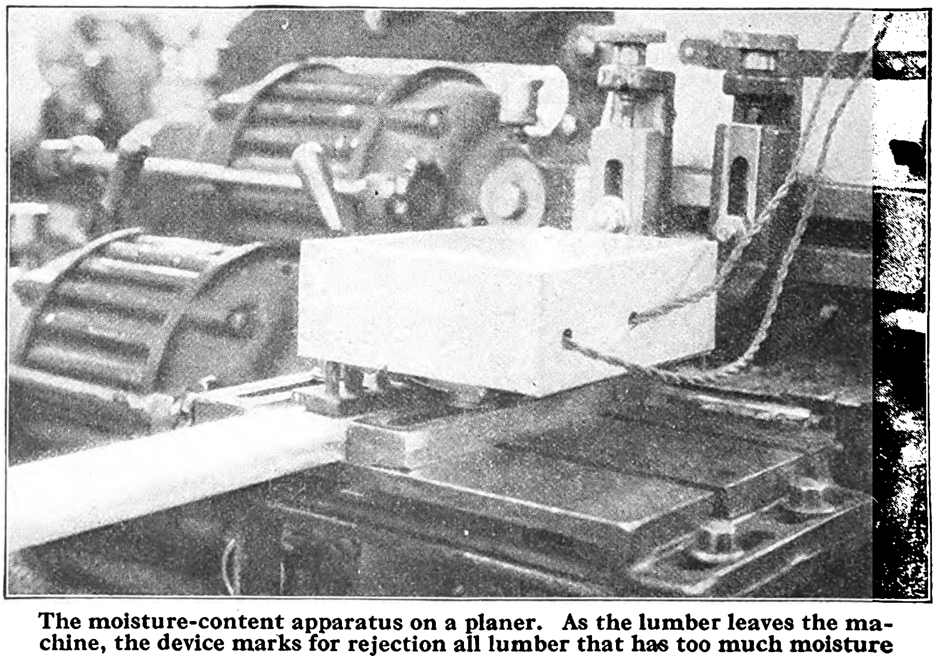
Device Measures Moisture in Lumber

THE market for American soft woods was for many years limited to construction fields where the principal items required were those entering into the building of dwellings, barns, outbuildings, fences, and so on, where specified moisture contents were of no moment or were easily met by the existing manufacturing practices. Higher standards in home and industrial engineering practices resulted in a call for more exacting standards covering the characteristics of lumber.

Lumber shrinks in drying. The degree of shrinkage bears a definite relationship to moisture content. In order to be



Portable device for measuring the moisture content of lumber. It consists of a two-point contact on a handle, and a meter and battery



The moisture-content apparatus on a planer. As the lumber leaves the machine, the device marks for rejection all lumber that has too much moisture suitable for the purpose intended, a large percentage of lumber must be dried to a moisture content sufficiently low to prevent further shrinkage after the job is in place. It must be sufficiently free from moisture to permit finishing to a smooth surface and in a condition to receive and retain a suitable stain or paint.

The Forest Products Laboratory and the research departments of the various lumber trade associations have made surveys of most wood-consuming industries and have largely determined the various moisture conditions desired. As Albert Hermann, research engineer of the Western Pine Association, put it "The most pressing need and the most difficult problem at present is a practical moisture content measuring device."

R. L. Shropshire testing one of the specially designed bubble sextants

T. E. Heppenstall, research engineer, of Longview, Washington, has produced just such a device. It is an electrically-operated moisture detector that automatically determines moisture content. This device may be placed at a convenient point at a lumber assorting table where kiln-dried lumber is being unstacked and graded out and will instantaneously mark out all pieces delivered over the grading table that are unsuitable to apply on a given moisture content specification. The unsuitable pieces, bearing the mark applied by the detector, may then be sent back to the kilns to be re-dried to the proper moisture condition or pulled into a bin by themselves to apply on other orders where the lower moisture content is not required. A like detector, with a slightly different marking device may also be attached to a planer machine and will mark out each piece of lumber either wholly or in part above required moisture content while the lumber emerges from the machine. A third detector with an attachment consisting of needle-like contact points and a signal lamp set in a handle may be used at the car door to test lumber being loaded for shipment. The same device may be used by the buyer at destination to check in his shipment to be sure that he is getting what he ordered.

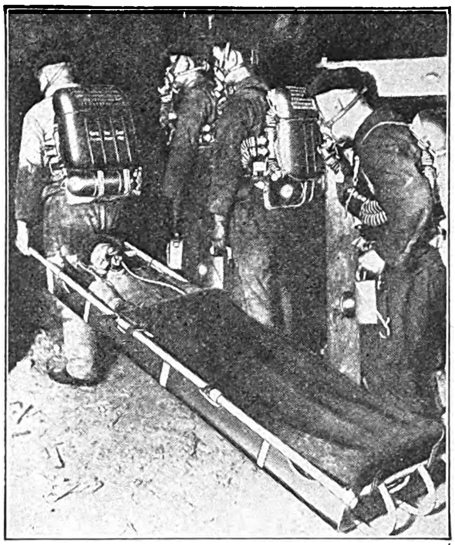
The Heppenstall invention is small, compact, and portable. It has but one moving part, is instantaneous in its action and may be operated from battery or light socket.

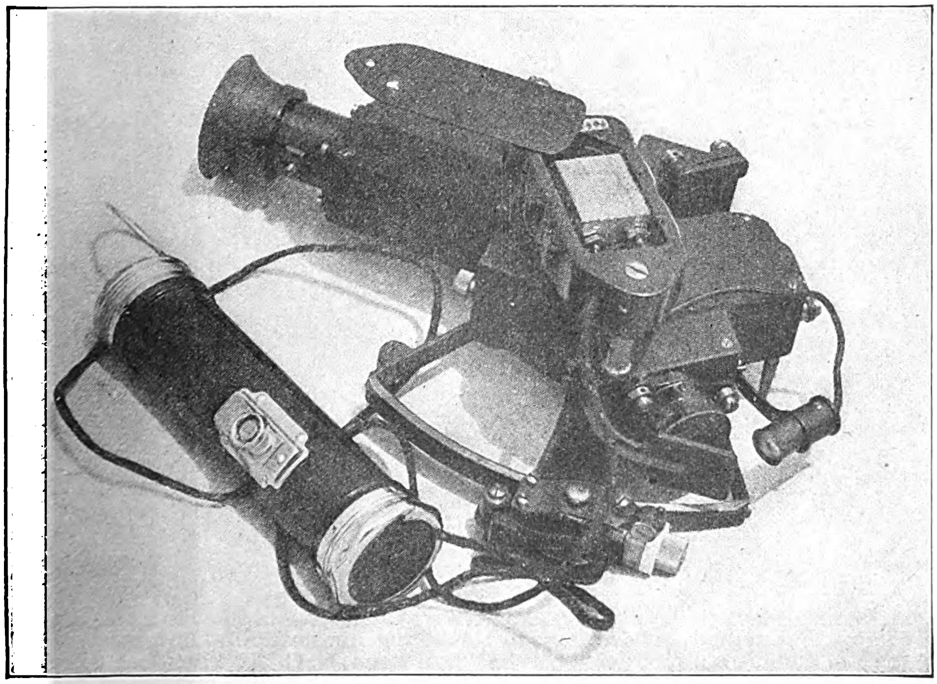
Mine Rescue Sledge-Stretcher

THE efforts of mine rescue crews are often retarded and sometimes nullified entirely by lack of equipment capable of taking care of rescued men under the varying conditions to be encountered. If the disabled or unconscious miner must be carried out through a narrow passage or up a narrow shaft, an ordinary stretcher does not suffice and, even if it did, the services of two men are required to carry a man to safety.

The firm of Drägerwerk in Lübeck, Germany, has perfected a sledge-stretcher which may be handled easily by one man. It has handles at one end while at the other the tube frame curves upward and around to form a two-point-contact skid. An apron straps tightly over the stretcher and extends up above the waist line of the man who is being carried. This apron holds the patient in place. Straps hold the man's head and shoulders. An oxygen tank and respirator are part of the equipment.

This sledge-stretcher can be carried in a horizontal position or in a vertical position, the latter being necessary sometimes when a man must be hoisted out through a narrow shaft.


A one-man stretcher such as this one, which is made in Germany, is often necessary in mine rescues


Bubble sextant taken on the Byrd Expedition. The bubble, indicating the visible horizon, is lighted, electricity being supplied by two flashlight cells

Bubble Sextant Lighted by Flashlight Cells

UPON two flashlight dry cells, contained in a hand flashlight case, may depend the ultimate success of the Byrd Antarctic Expedition in its effort to circle the South Pole by airplane. Two intricately designed bubble sextants, one for the use of the expedition's Assistant Navigator, Ralph L. Shropshire, and one for use by Commander Byrd, as Chief Navigator, were taken on the *S. S. Larson* to the Antarctic. A bubble in the sextant corresponds to the visible horizon in observations taken to show the relationship between the sun and the visible horizon. At night or in cloudy periods of the day the bubble and sextant are illuminated by a bulb lighted by the flashlight cells, and thus it becomes possible to obtain accurate positions.

This becomes of supreme importance when the tri-motored Ford airplane takes off during the Antarctic six-months night or during stormy or cloudy weather, for South Pole excursions from the expedition's Antarctic base.

Failure to obtain proper bearings might easily throw the plane out of its course. By devising the flashlight case with its dry cells as a power source, Shropshire stated just before leaving New York that he believed he had overcome what promised to be an obstacle to successful position finding. Hitherto a much smaller dry cell has been employed in the handle of such sextants, the cell of necessity being made so tiny, in order to fit in the handle, that it afforded only a minimum power supply to run the light bulb, before exhaustion.

Shropshire is carrying with him several hundred extra flashlight cells, for use by

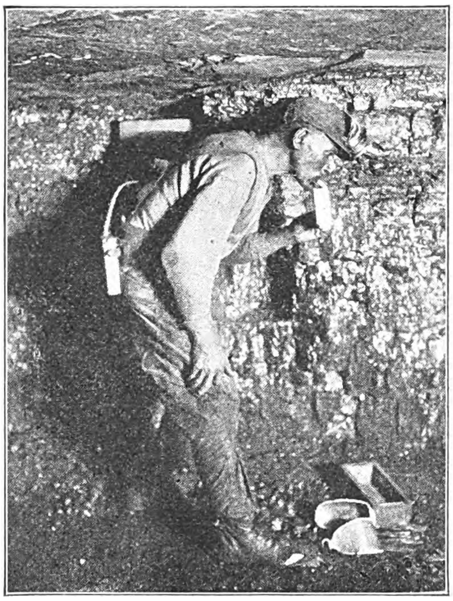
(*Please turn to page* 180)

Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

"Self-Rescuer" for Gas-Filled Mines

WITH carbon monoxide being blown into the city streets from millions of automobile exhausts, everyone is more or less interested in the poisonous effects of this gas on the human system and in methods of protection against it. It is in the mines where this dreaded gas constitutes a real and terrible danger, after fires or explosions, and it is with the safety of miners foremost in mind that the United States Bureau of Mines has done its extensive experimental work on gas masks and respirators of all kinds.



This respirator is effective as a safeguard against carbon monoxide

Recently there has been developed the device known as the "self-rescuer." S. H. Katz and J. J. Forbes describe it in Miner's Circular 30, published by the Bureau of Mines, as follows:

"'Self-rescuers' are pocket-size respirators that protect the wearer from air contaminated with the poisonous gas, carbon monoxide. The purpose of the 'self-rescuer' is to provide a miner with protection from carbon monoxide for at least half an hour and thus help him to escape from a mine in which a fire is burning or an explosion has occurred. A 'self-rescuer' can be used also by workers above ground who may through accident become surrounded by atmosphere containing carbon monoxide.

"Two hazards threaten the miner who escapes serious injury by fire or violence in a large mine fire or explosion. He may be poisoned by carbon monoxide or he may be suffocated by breathing an atmosphere that does not contain enough oxygen to support life. In order to save himself, the miner must either erect a barricade against afterdamp and wait until ventilation is restored, or take a long chance of getting out of the mine through entries free of afterdamp. Although the 'self-rescuer' does not supply oxygen, it does remove the hazard of carbon monoxide for half an hour or more and thus greatly increases a miner's chance of getting out alive. Thus the 'self-rescuer' is a life-saver for the miner, and 'self-rescuers' are as essential in mines as life preservers on ships.

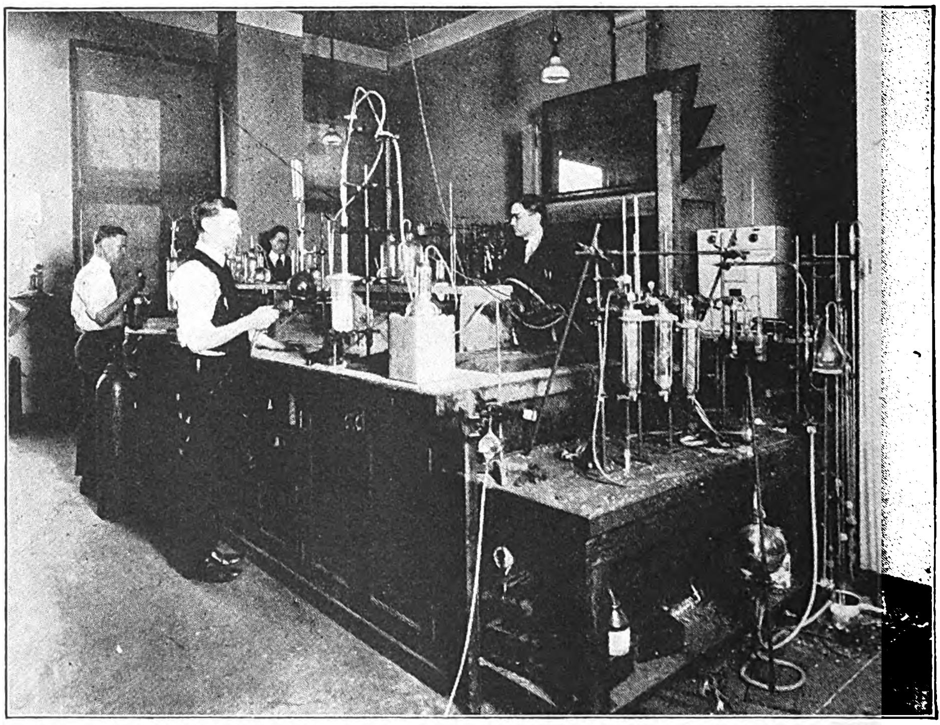
"The 'self rescuer' is a small canister made of tin plate, to which a mouth piece is directly attached. The wearer breathes by his mouth through the 'self rescuer'; breathing through the nose is prevented by a pinch clamp or nose clip on the nostrils. Both the nose clip and the 'self rescuer' are kept in the case, and a short cord between them keeps the nose clip from being lost.

"When the 'self rescuer' is put in use, the air the wearer breathes passes through certain essential parts and materials. First, inhaled air enters through small holes in the canister at the lower side (as held in the mouth) and then filters through absorbent cotton, held between wire screens, which removes smoke. Next is a layer of granular (14 to 20 mesh size) fused calcium chloride (90 cubic centimeters or five and one half cubic inches in volume), to absorb water vapor, which is always present in air and destroys the efficiency of the 'hopcalite', the material in the next layer. Hopcalite is a granular (14 to 20 mesh size) mixture of specially prepared manganese dioxide and copper oxide; 110 cubic centimeters (six and three quarter cubic inches) are put into the canister. This layer is separated from the calcium chloride by wire gauze. Hopcalite acts as a catalyzer; that is, it causes any carbon monoxide (CO) and oxygen (O_2) in the air that passes through it to unite and produce the relatively harmless carbon dioxide (CO_2)."

Novel Drying Trick Applied in Dynamite Manufacture

EXPLOSIVES manufacturers have, for some years past, been racing to produce dynamites of lower and lower density. Reducing the density of the explosive reduces the undesirable shattering effect in blasting out coal, for instance. To reduce the density of their dynamite they have used wood pulp, soaked in a solution of ammonium nitrate as the absorbent medium for the nitroglycerine. But a serious disadvantage of carbonaceous materials impregnated with ammonium nitrate is the difficulty and danger of drying. Ammonium nitrate retains water tenaciously at rather high temperatures, and long periods of drying are necessary to dry a moist mixture of ammonium nitrate and wood pulp. The dynamites made in this way are satisfactory as to explosive characteristics, but the risk of manufacture is too great to warrant their adoption.

A recently developed method of avoiding these difficulties, is described in a recent issue of *Chemical and Metallurgical Engineering* by B. I. Stoops. It consists of mixing with the ammonium nitrate a few percent of hydrated magnesium nitrate (United States Patents 1,671,792 and 1,671,793). Hydrated magnesium nitrate



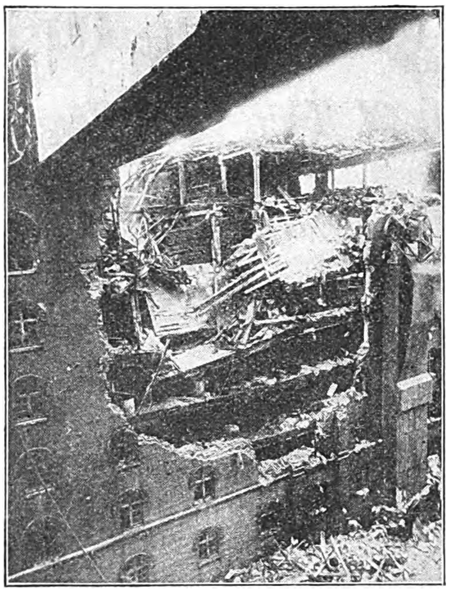
Pressures of 3000 pounds per square inch and temperatures lower than −300 degrees, Fahrenheit, are frequent in this Cryogenic Research Laboratory of the United States Bureau of Mines in Washington, D. C. The research data supplied by this laboratory were of primary importance in determining the production cycle of the new helium gas plant at Soncy, near Amarillo, Texas melts in its water of crystallization at 198 degrees, Fahrenheit. After mixing in the proportions of 20 percent of hydrated magnesium nitrate and 80 percent of ammonium nitrate, the mixture melts in its water of crystallization at 230 to 240 degrees, Fahrenheit. When thus melted it can be incorporated with balsa sawdust and will impregnate the latter thoroughly. Upon cooling, the water present reverts again to the form of water of crystallization and the mixture is then to all intents and purposes physically dry. Thus the dangerous and expensive operation of drying mentioned above is completely avoided.

This clever application of a simple bit of chemical knowledge has produced a dynamite with very decided advantages.

Humidity Control Prevents Explosions

RADIO has taught us to associate the word "static" with horrible noises, but we sometimes recall, on second thought, that the phenomenon referred to is fundamentally electrical and was only a mild novelty even in the days when we stroked the cat the wrong way in the dark to watch the sparks. In this connection, we recall the experience of the New Bedford city fathers who devised a closed chamber filled with illuminating gas for the merciful dispatch of stray tomcats. In several instances some particularly lively specimens, presumably with a number of their nine lives still in reserve, greatly accelerated the execution by discharging static sparks in the explosive atmosphere.

Static discharges have been responsible for many disasters where explosive chemicals are used. For example, it has been stated that every year 1000 women are burned to death as a result of fires from dry-cleaning at home. Even the commercial dry cleaners have experienced such explosions caused by static sparks, produced by the scrubbing, igniting the naphtha or other solvent. Dr. C. H. Wardell, Jr., Chief Chemist of the Ohio Chemical and Manufacturing Company of Cleveland, pointed out in a recent issue of *Hospital Progress* that there is a remedy for static electricity. Industry has already solved its problem. Increased humidity supplemented in certain cases by proper grounding has reduced the static hazard to a negligible quantity.



This picture is silent testimony of the destruction caused by a dust explosion in a large industrial plant

"The percentage of relative humidity required to dissipate static charges is a question of debate; however, we may well be guided by the previous experience of other investigators in similar fields. One authority states that a relative humidity of 50 percent at 70 degrees, Fahrenheit, entirely disposed of static troubles in a rubber factory. Another company handling flammable materials also found that 50 percent relative humidity prevented explosions from static. A well-known dry-cleaner, having experienced six explosions, and having exhausted all other means, raised the relative humidity to 40 percent and had no further trouble. It has been shown that a relative humidity of 45 percent gives a safe atmosphere, preventing static difficulties and consequent fires in the churn and spreader rooms of the rubber industry."

Dangers in Dust Pointed Out By Expert

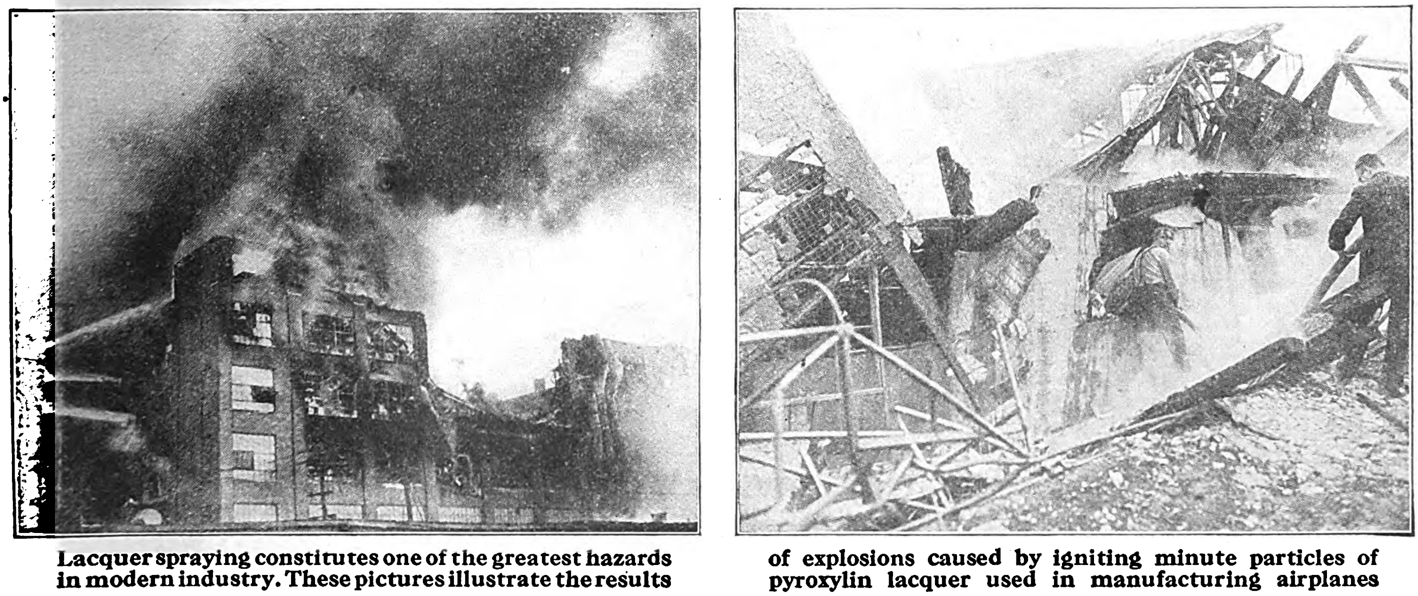
CONSIDERABLE attention has been given in recent years to dust explosions in industrial plants. The dust explosion research studies in the Bureau of Chemistry and Soils of the Department of Agriculture have been confined for the most part to grain handling or milling industries. In many instances, however, the Bureau has been called upon for assistance by many other types of industries in which dust explosions have occurred and in which protection was essential. David J. Price, engineer in charge of the Chemical Engineering Division of the Bureau, (*See also page 552, June, 1928, issue,* SCIENTIFIC AMERICAN.—*Editor*) is probably the country's leading authority on this hazard and to him we are indebted for the photographs reproduced herewith.

Research studies of the Bureau of Chemistry and Soils have demonstrated that when mixed with air in proper proportions combustible dust of almost all types can be ignited with explosive violence. There are at least 28,000 industrial plants in the United States subject to the hazard of dust explosions, according to the estimate of Mr. Price. These plants employ approximately 1,324,000 people and annually manufacture products valued at more than 10,000,000,000 dollars.

In recent years dust explosions have occurred in many industries where they had not previously taken place so that the number of industrial plants where the dust explosion hazard exists appears to be constantly increasing. In addition to the explosions in what might be termed grain handling and milling operations, there have been explosions from the dusts of starch, sugar, powdered milk, chocolate, spice, rice, cotton-seed meal, wood, powdered rubber, paper, fertilizer, sulfur, zinc, magnesium, dye materials, coal tar pitch, leather, and many others. Minor explosions often cause serious fires.

As a result of extensive experimental work by the Bureau of Chemistry and Soils and observations made during actual operation of inert gas systems in industrial plants, the value of inert gas as a means of preventing dust explosions has been so well demonstrated that its use should be seriously considered wherever an explosion hazard exists which cannot be controlled through the elimination of the dust cloud or the source of ignition. The use of inert gas is particularly recommended in grinding, bolting, or any phase of a manufacturing process where an explosive dust is produced or handled in an enclosed piece of equipment.

(*Please turn to page* 176)



Lacquer spraying constitutes one of the greatest hazards in modern industry. These pictures illustrate the results of explosions caused by igniting minute particles of pyroxylin lacquer used in manufacturing airplanes

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York City

The Chicago Air Show

THE recent air show at Chicago brought together exhibits of every type of plane, engine, and accessory. It was held in the Chicago Coliseum with an overflow in the near-by armory. There were over 75 planes of different types on display and perhaps 25 different aircraft engines.

The show commemorated the 25th anniversary of heavier-than-air flight, when the Wright brothers made their first flight on December 17, 1903.

The Hon. Irving W. Glover, Assistant Postmaster General, announced to visiting delegates of the International Aeronautical Conference (held in Washington) that with the completion of certain new lines, and the granting of additional air mail contracts, a letter mailed in Montreal on Monday at noon would arrive in Santiago, Chile, by the following Saturday.

Air lines already cover the greater part of the United States, and aviation is rapidly encompassing Central and South America.

On November 1, 1928, there were 55 operators of air transport routes in the United States. Forty of these carried passengers in addition to mail and express, while 20 were devoted to passenger traffic exclusively. With the coming of 1929, there may be three (certainly two) transcontinental passenger services in operation, equipped with large tri-motored planes of the most luxurious type.

During the month of October, air-mail contractors handled 467,422 pounds of mail, which may be roughly estimated at 8,000,000 letters, an increase of 10 percent over the preceding month.

At the present time there are 14,941 miles of airways in operation in the United States. More than 40,000 miles are flown daily by the regular commercial services, and when the new lines scheduled are put into effect, the daily mileage will amount to 51,000.

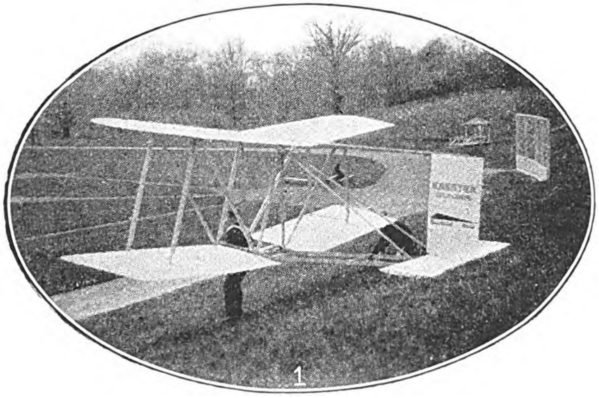
A recent report of the Aeronautical Chamber of Commerce indicates a tremendous increase in airplane production. In 1921 not a single commercial airplane was built. In 1927, there was a production of less than 2000 planes with a total value of 14,000,000 dollars. For 1928 the report of the Chamber indicates a construction of 4000 planes of all types, with a market value of 25,000,000 dollars. For 1929, members of the Chamber have a schedule of 10,000 to 12,000 planes, the market value of which will exceed 100,000,000 dollars.

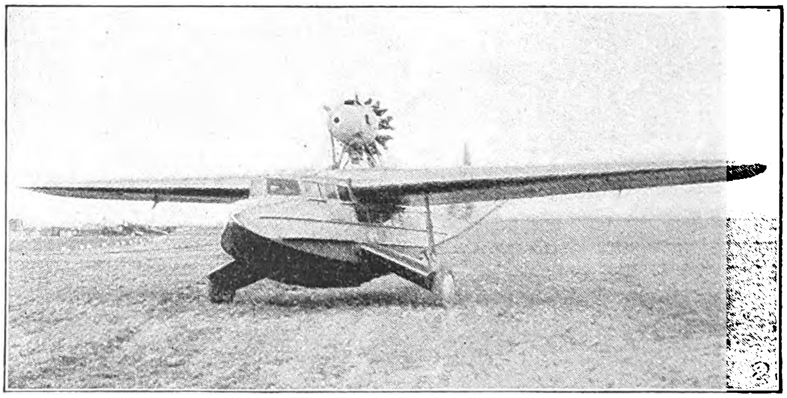
The year has seen financing of aircraft companies, planes, engines, and transport to a value of at least 50,000,000 dollars. Aircraft securities are purchased by the public as soon as issued. [*See page 148. Ed.*]

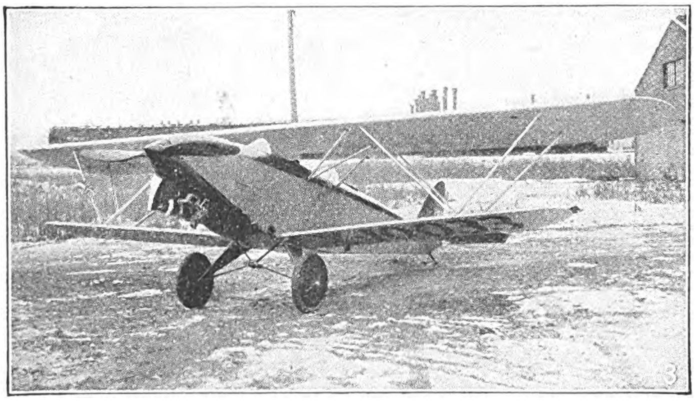
On September 1, 1928, there were 1196 airports and landing fields in operation in the United States. Airports fully equipped with flood lights for landings, flood-lighted buildings, boundary lights, danger lights, et cetera, are to be found in almost every state of the union.

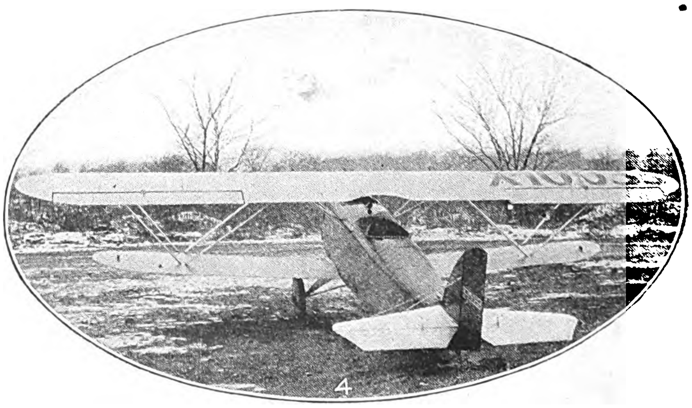
On October 31, there were, according to a census of the Department of Commerce, 4134 privately owned planes, and the number of such privately owned planes is rapidly increasing. California leads all other states in plane population, with 639 planes used by civilians. New York state ranks second with 387 planes, and Illinois ranks third with 350.

There are now 2678 licensed pilots in the United States. In this number military and naval pilots are not included. The Department of Commerce reports that pilots receive from 35 dollars to 150 dollars per week, and the average salary of a competent pilot ranges between 75 dollars and 100 dollars. The large transportation services such as National Air Transport, Boeing Air Transport, et cetera, give their aviators a steady base pay, which, coupled with mileage, nets the pilot something like 5000 dollars per year. At the present time, while there is no lack of pilots of ordinary caliber,









Some of the new aircraft seen at the Chicago exhibition. See also text above. 1: The Kasstek American-built glider, which is on the market and offered for sale to private flyers. 2: A striking view of the latest Sikorsky amphibian. The stubs raise when the wheels are retracted, and the wheels disappear within them. 3 and 4 are views of the Driggs *Skylark*, a plane powered with a 60 horsepower, four cylinder in-line, inverted engine

Manufacturers and inventors use this *grainless* wood to make good products better

The making of broad pieces, peculiar shapes and curved surfaces often makes it difficult to obtain low cost production. But Masonite Presdwood solves these trying problems. This grainless wood is readily cut, sawed, punched, or curved. It resists moisture and takes any finish. Write for a generous sample. Then try it for yourself.

FOR RAILROAD COACH CEILINGS

Reports of new uses for this grainless wood are coming in daily. A manufacturer solves a production problem, cuts costs or widens his market. A mechanic develops new ways of working and finishing it. An inventor finds it meets requirements better than any other material. And—three years after placing Masonite Presdwood on the market—we, who make and sell it, are still wondering just how far its range of usefulness will finally extend.

Builders of fast motor boats and outboard hydroplanes say that Presdwood gives their craft lightness, strength and speed. Contractors use it for concrete forms because the resulting smooth surfaces cut their labor costs to the bone. And from far and near come orders from makers of road signs who wish to take advantage of Presdwood because it is easily worked and quickly painted.

Presdwood IS wood

Presdwood is made of wood—exploded to separate the fibres—then formed, with heat and enormous pressures, into uniform boards, 1/8 inch thick, four feet wide and twelve feet long. The same wood binder (the lignins) that held the wood fibres together, again cements the fibres of Presdwood, but now there are no knots, no grain, and no cracking, checking or splitting to mar the beauty of the finished product, or worry the manufacturer.

FOR BEDROOM SCREENS

Where broad surfaces, beautifully finished, are essential—there you will find Presdwood. It is used in paneled walls of apartments and office buildings. It is used for broad side panels of motor truck bodies and the interiors of Pullman cars. And in the moving picture studios of Hollywood it is artistically employed to portray the ballrooms of the rich and the palaces of kings.

Does not warp ~ resists moisture

Because of its freedom from warping and buckling, and because of its resistance to moisture, we find Presdwood used for the tension boards of radio loud speakers, for bedroom screens, work bench tops, campers' tables, bread boxes, dairy product containers and starch trays for candy factories.

And when you try Presdwood for yourself, you will find that it will solve a manufacturing problem, reduce costs or make a good product even better. Write for a large free sample. It will be sent promptly on request.

MASONITE CORPORATION
Sales Offices: Dept. 734, 111 W. Washington St.
Chicago, Illinois

FOR CONCRETE FORMS ON FACADE ARCHES

Mills: Laurel, Mississippi

Masonite
PRESDWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

FOR MOVIE STUDIO SETS

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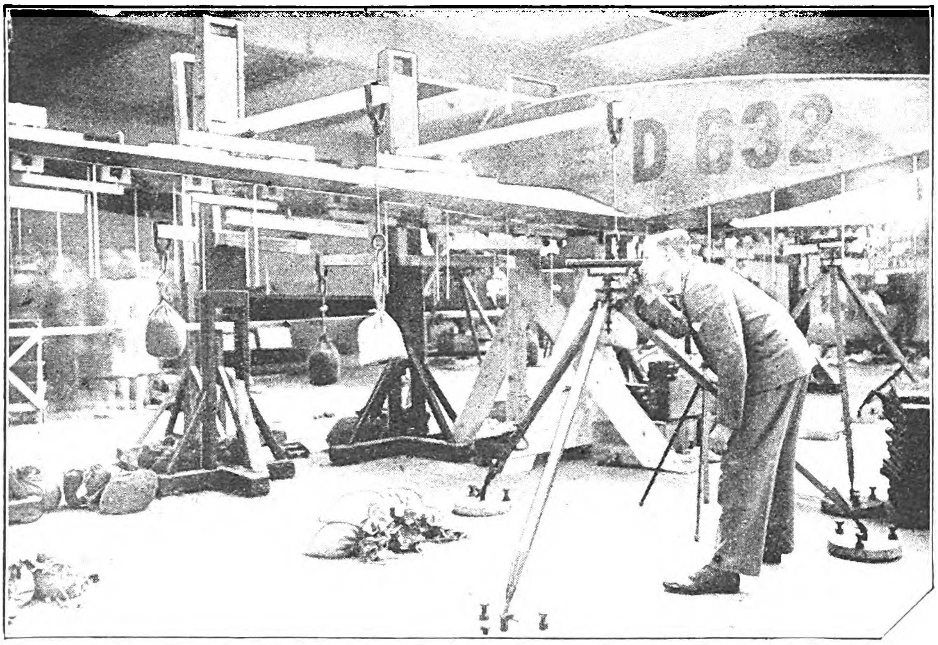

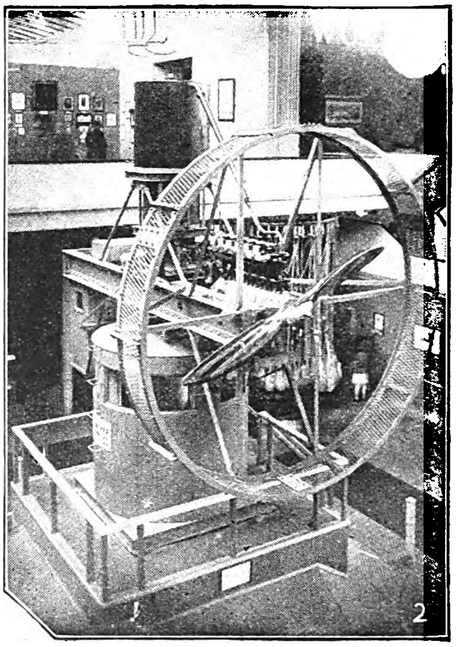

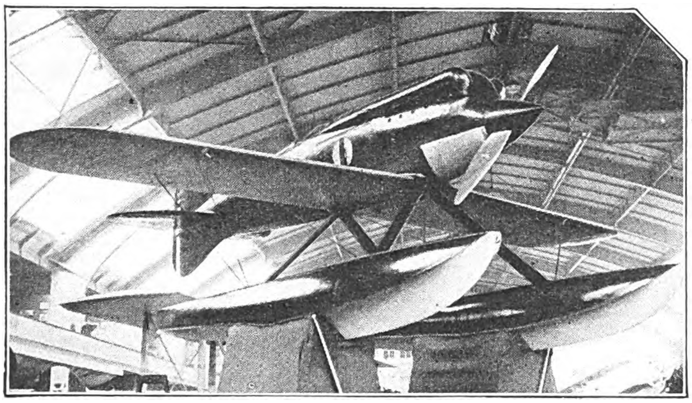

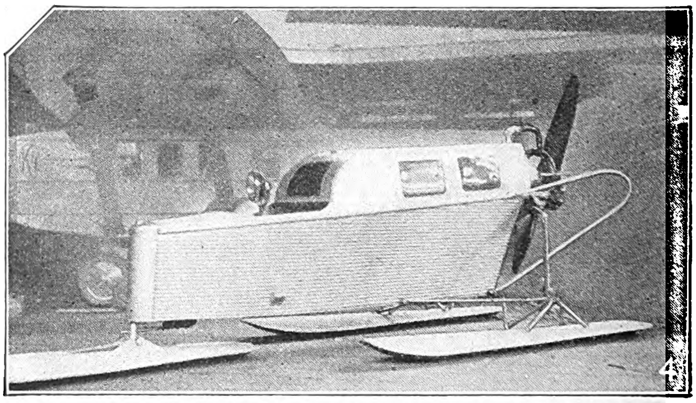

Exhibits at the International Air Travel Exposition held recently in Berlin. 1: Testing the wings of a monoplane. The ship is inverted as explained in these columns. The observer watches the degree of bending. 2: A huge testing stand for aircraft engines. 3: The Italian monoplane, *Macchi 52,* which made a flight at 328 miles per hour. 4: While not an aircraft, this sledge embodies refinements developed for aerial use

the demand for qualified transport pilots with a thousand hours or more to their credit greatly exceeds the supply. Apparently the training of pilots is one of the pressing problems of the day. To meet this situation the Curtiss Flying Service is planning the establishment of 75 training schools, with 25 scheduled for early operation.

At the Aircraft Manufacturers' Section meeting of the Aeronautical Chamber of Commerce, the regulation of flying schools was one of the most important questions discussed. It was recommended that all schools recognized by the Chamber should have as minimum requirements instruction courses that would qualify students for a private pilot's license and that a certificate from the school should only be given on completing such a course. The Flying School Committee further recommended that every school should use exclusively planes licensed by the Department of Commerce and that every instructor should have a transport pilot's rating.

Another point taken up by the Aircraft Manufacturers' Section was the question of standardized performance testing. The Aeronautical Chamber of Commerce, in conjunction with various universities giving courses in aeronautical engineering, will carry out a plan of standardized performance testing, so that manufacturers' advertisements may be absolutely reliable in this respect.

At the show, the general tendency seemed to indicate a search for still greater speed on the one hand, and more attention to passenger comfort, cabin, and door finish on the other. A striking example of the latter tendency was the new Fokker amphibian, in which comfortable seats are supplemented by two attractive couches. This ship, equipped with a Pratt and Whitney Wasp motor of 400 horsepower, was one of the "star" exhibits. The design of the retractible landing gear is particularly ingenious mechanically. As the wheel is retracted, the stub wing is raised, and the wheel disappears within the stub.

An American built glider, with wings rigidly trussed with dural tubing, and an outrigger tail, with the man standing upright at the instant of launching, was exhibited for sale and met with much interest.

There is quite a vogue for in-line, air-cooled engines. The famous Cirrus Mark III engine was exhibited by the American Cirrus Engines company which is going to put the engine into production in the United States.

Inverting the engine seems to attract the plane designer. The Driggs *Skylark* is equipped with a 60 horsepower, four-in-line, Rover engine. The inverted engine gives the upper part of the fuselage nose a particularly clean appearance and removes cylinder heads and the like from the pilot's view. The Driggs *Skylark* is advertised as the "personal airplane." It is said to have a high speed of 110 miles per hour, and a climb of 900 feet per minute. Its weight, empty, is 665 pounds. With fuel and oil for 300 miles and pilot and passenger it weighs only 1115 pounds. The price "flyaway" is about 3200 dollars.

ILA

THE recent Internationale Luftfahrt Ausstellung (ILA), (literally International Air Travel Exposition), at Berlin contained so many interesting exhibits that it is difficult to select the more striking novelties.

At their expositions the Germans believe in informing the public of the scientific methods underlying aircraft construction. In our shows, engines, planes and accessories only are reckoned among the exhibits. One of the exhibits at Berlin shows a wing in process of strength testing. The fuselage is mounted in a solid jig, and in an inverted position, with the wings attached. When the wings are loaded, the force of gravity simulates the air forces which in flight are upwards. The loads are applied gradually—one, two, three and even more

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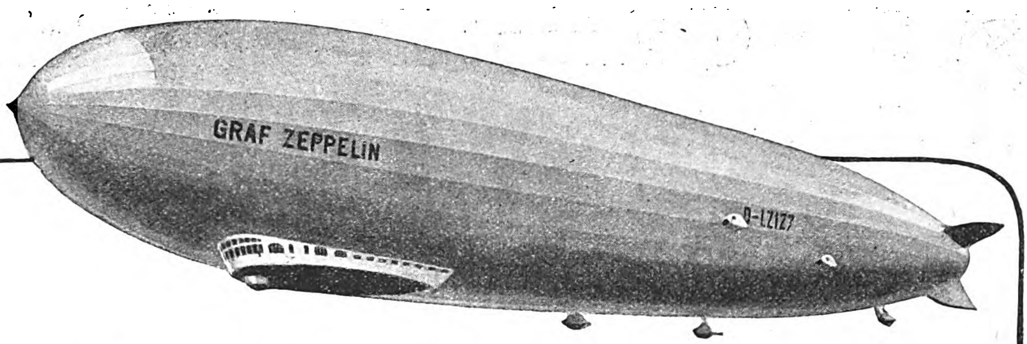


"I smoke a Lucky instead of eating sweets."

Grace M. Hay Drummond Hay

Lady Grace
Drummond Hay,
only female passenger on the
Graf Zeppelin.

LUCKY
STRIKE
LUCKY
STRIKE
"IT'S TOASTED"
CIGARETTES

Lady Grace
Drummond Hay,
first woman to fly the
Atlantic from Europe
to the United States.

"The fact that we were not permitted to smoke from the time the Graf Zeppelin left Friedrichshafen until we landed at Lakehurst only increased my appetite for a Lucky Strike. Oh, how good that first one tasted! I'm really keen for Lucky Strike—the toasted flavor is delightful. I smoke a Lucky instead of eating sweets—that's what many men have been doing for years. I think it high time we women smoked Luckies and kept our figures trim."

LADY GRACE DRUMMOND HAY

The modern common sense way—reach for a Lucky instead of a fattening sweet. Thousands are doing it—men keep healthy and fit, women retain a trim figure.

Lucky Strike, the finest tobaccos, skilfully blended, then toasted to develop a flavor which is a delightful alternative for that craving for fattening sweets.

Toasting frees Lucky Strike from impurities. 20,679 physicians recognize this when they say Luckies are less irritating than other cigarettes. Athletes, who must keep fit, testify that Luckies steady their nerves and do not harm their physical condition. That's why Luckies have always been the favorite of those men who want to keep in tip-top shape and realize the danger of overweight. That's why folks say: "It's good to smoke Luckies."

A reasonable proportion of sugar in the diet is recommended, but the authorities are overwhelming that too many fattening sweets are harmful and that too many such are eaten by the American people. So, for moderation's sake we say:—

"REACH FOR A LUCKY
INSTEAD OF A SWEET."

Reach for a Lucky instead of a sweet.

"It's toasted"

No Throat Irritation-No Cough.

© 1929, The American Tobacco Co., Manufacturers

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Construction

NATIONAL LUMBER PRODUCTION REGISTER AND DIRECTORY is a 165-page index of lumber manufacture by states, producers, products manufactured, and varieties of wood used. This handbook is a standard guide to all marketing phases of the industry. *National Lumber Manufacturers' Association, Transportation Building, Washington, D. C.—Gratis.*

A STUDY OF THE FAILURE OF CONCRETE UNDER COMBINED COMPRESSIVE STRESSES, BULLETIN NO. 185, deals with an investigation of the failure of concrete under compound stresses from varying directions. The aim of the tests was to study the internal action of the material as it breaks down under comparative pressures, and to determine the ability of concrete to resist longitudinal stresses. *Engineering Experiment Station, University of Illinois, Urbana, Illinois.—Gratis.*

OLD PAVEMENTS MADE NEW describes many instances where paved roads have been successfully re-surfaced with asphalt. The illustrations represent many sections of the country, and apply to a wide variety of traffic conditions. *The Asphalt Association, 441 Lexington Avenue, New York City.—Gratis.*

TYPHOON FANS AND VENTILATING SYSTEMS, a 102-page booklet, portrays a wide variety of cooling, heating, and ventilating system installations. The booklet is copiously illustrated with photographs, diagrams, and flow-sheets, showing methods of providing properly cooled or heated fresh air to theaters, restaurants, hotels, and public buildings. *Typhoon Fan Company, 345 West 39th Street, New York City.*

SELECTING CULVERTS AND DRAINS ON THE BASIS OF COST PER YEAR is a helpful 22-page booklet, particularly for those engaged in highway, railway, or municipal construction. This little booklet shows how to evaluate various types of structures serving the same purpose. *Armco Culvert Manufacturers' Association, Middletown, Ohio.—Gratis.*

Fuel

NATURAL GAS MANUAL FOR THE HOME, TECHNICAL PAPER NO. 325, will be of general interest in communities supplied, or to be supplied, with natural gas. *United States Bureau of Mines, Department of Commerce, Washington, D. C.—Gratis.*

INDUSTRIAL GAS IN THE UNITED STATES—GROWTH AND TRENDS presents discussion and statistics showing how the sale of natural, manufactured, coke-oven, and blast-furnace gas has varied during the past decade. The paper is illustrated with photographs showing typical applications of gas consumption in major industries. *American Gas Association, 420 Lexington Avenue, New York City.—Gratis.*

FIVE HUNDRED TESTS OF VARIOUS COALS IN HOUSE HEATING BOILERS, BUREAU OF MINES BULLETIN 276, is a 74-page treatise covering an extended study of the comparative heating values of various kinds of coal from different parts of the country. A bibliography of fuels and heating equipment is included in the bulletin. *Superintendent of Documents, United States Government Printing Office, Washington, D. C.—15 cents.*

Manufacturing

COTTON FABRICS AND THEIR USES is a little pamphlet of interest to anyone even remotely connected with the cotton or textile industries. *New Uses Section, Textile Division, Bureau of Foreign and Domestic Commerce, Washington, D. C.—Gratis.*

COMPETITORS WHO HAVE CO-OPERATED TO IMPROVE QUALITY is a well-prepared 30-page booklet describing an interesting organization that has worked out a practical solution to the problem of industrial competition within a limited field. *Electrical Steel Founders' Research Group, 541 Diversey Parkway, Chicago, Illinois.—Gratis.*

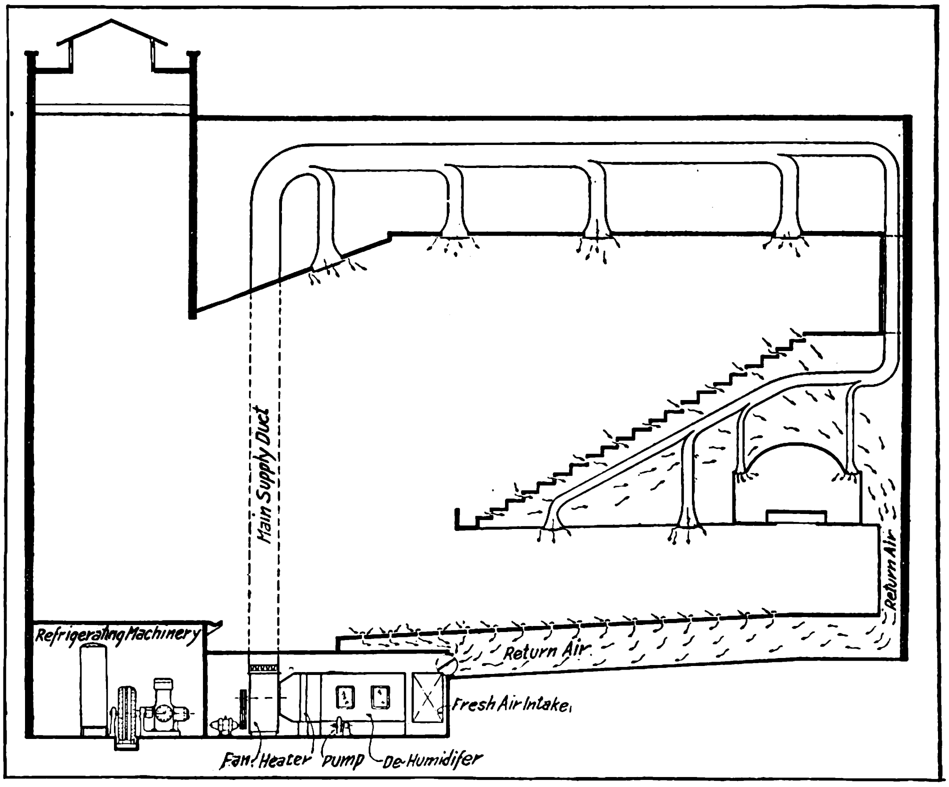
PRODUCTION OF EXPLOSIVES IN THE UNITED STATES DURING 1927, BUREAU OF MINES TECHNICAL PAPER 435, shows not only the production of explosives in this country during the period covered, but also presents statistics showing the amount used by various industries in the United States and abroad. *Superindendent of Documents, United States Government Printing Office, Washington, D. C.—10 cents.*

Metals

SUMMARIZED DATA OF COPPER PRODUCTION is a study of the production of copper during the 19th and 20th Centuries, through the year 1927. This paper graphically illustrates the increasingly important part played by the United States in supplying the world with this important metal. This report is the first of a new series presenting similar long-time production data of the other common metals. *United States Bureau of Mines, Department of Commerce, Washington, D. C.—Gratis.*

PHOTOMICROGRAPHY AND ITS APPLICATION TO MECHANICAL ENGINEERING, a 20-page illustrated paper by F. F. Lucas of the Bell Telphone Laboratories, presents a series of observations by the aid of high-power metallography and the ultra-violet microscope on the hardening of steel. *The Bell Telephone Laboratories, 463 West Street, New York City.—Gratis.*

(*Please turn to page* 179)



This sketch from the booklet *Typhoon Fans and Ventilating Systems* shows a theater installation which automatically controls humidity and temperature

Sore throat

breeds in crowded, drafty places

Gargle when you get home

JOINED YET?
Get in the circle of men who've found the perfect shave—the cool shave with
LISTERINE
SHAVING CREAM

Listerine full strength *kills even typhoid germs in 15 seconds*

As soon as nasty weather sets in, thousands are down with sore throat, colds, grippe, flu, or worse.

Don't be one of them. Gargle with Listerine full strength every day—especially after exposures to rain, severe cold and coughing crowds in public places—buses, street cars and movies. This simple act may spare you a costly and possibly a dangerous siege of illness.

Because Listerine, full strength, is powerful against germs—and sore throat, like a cold, is caused by germs.

Repeated tests show that Listerine kills even the stubborn B. Typhosus (typhoid) and M. Aureus (pus) germs in 15 seconds.

Realizing Listerine's power you can understand its effectiveness against the milder winter complaints caused by germs. Each year increasing millions rely on it.

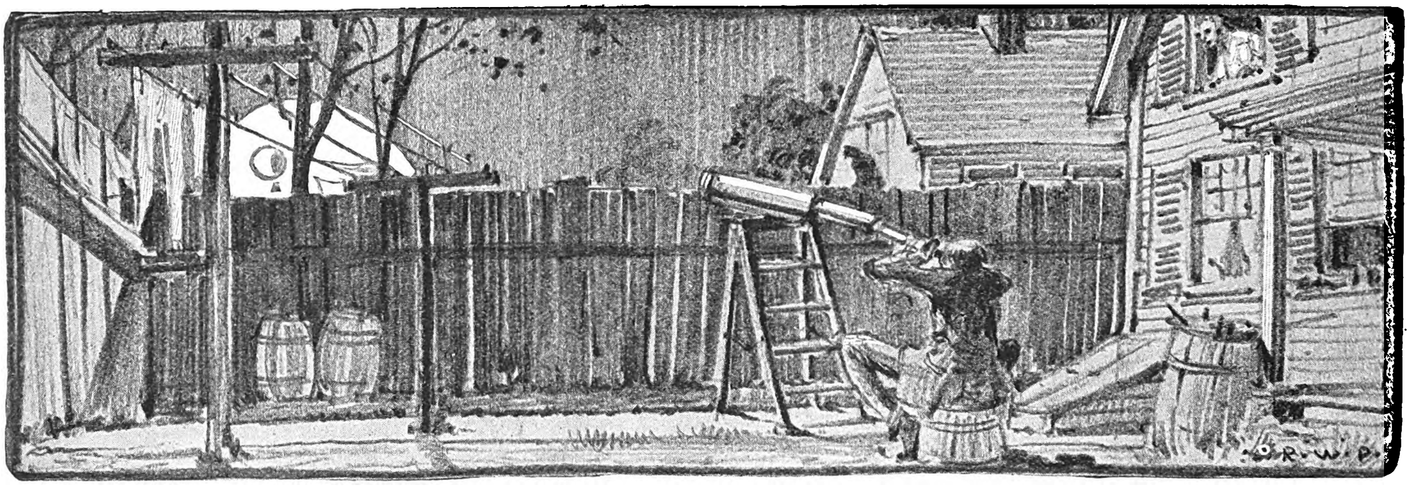
Keep a bottle handy and at the first sign of trouble, gargle repeatedly. Don't hesitate to use it full strength. It is entirely safe in any body cavity.

If a throat condition does not rapidly yield to this treatment, consult your physician. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

The safe antiseptic

Fewer colds
—*if you do this*

Millions of colds start when germs, transferred from the hands to food, enter the mouth. Therefore, before every meal, rinse your hands with Listerine. This effectually destroys disease germs. This simple act may save you a nasty siege with a cold. And it is especially important for mothers to remember when preparing children's food.



The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

NOW that we amateurs in the north are finding it so easy to keep cool this month at our telescopes, a picture of the Southern Cross Observatory in Miami, Florida, showing amateur astronomers dressed in Palm Beach suits, may have some sort of an effect upon our feelings. Clarendon Ions, joint author of the SCIENTIFIC AMERICAN instruction book *Amateur Telescope Making*, sends in the photograph. He states that "this observatory was endowed seven years ago by Mr. S. Lynn Rhorer, F.R.A.S., of Atlanta, Georgia, who started then with one telescope. Each year one is added by Mr. Rhorer, who also augments the staff of volunteer trained assistants. All the glasses are Clarke refractors.

"Some nights 3000 or more people attend, and they are given opportunity to view some celestial objects and hear various educational talks. The average this winter is 1500 per night, the observatory closing at 10 P.M. Early morning observing is done two mornings per week, and attended by only a few of the faithful."

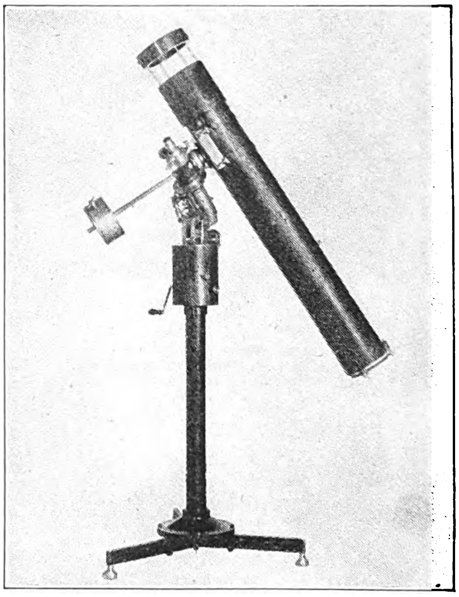
Leslie Long, of Cornelius, Oregon, describes a rather unusual telescope as follows:—"The mount, which was made by Jesse Watson, is of the equatorial type with hollow declination axis, with the eyepiece in a fixed position on the end of the polar axis. All the parts were machined out of stock material, with the exception of a two and one half inch pipe "T", a phonograph motor and a Ford front spindle, which is used for the polar axis. The spindle is rotated by gears, through a friction clutch built into the brake drum. The clutch allows motions of the spindle without the gears, if desired. The "T" was dressed up in a lathe and a steel bearing for the declination bearing was fitted in the side opening. In the remaining opening a steel fitting was placed, which holds the eyepiece tube and focusing arrangement, as well as one of the prisms, this being three quarter inch size.

"A one and one-half-inch prism is mounted inside the tube, both prisms being in line with the declination axis and bringing the light from the mirror to the eyepiece with any position of the telescope. The tube is balanced on the declination axis by a lead weight, and about the polar axis by another weight.

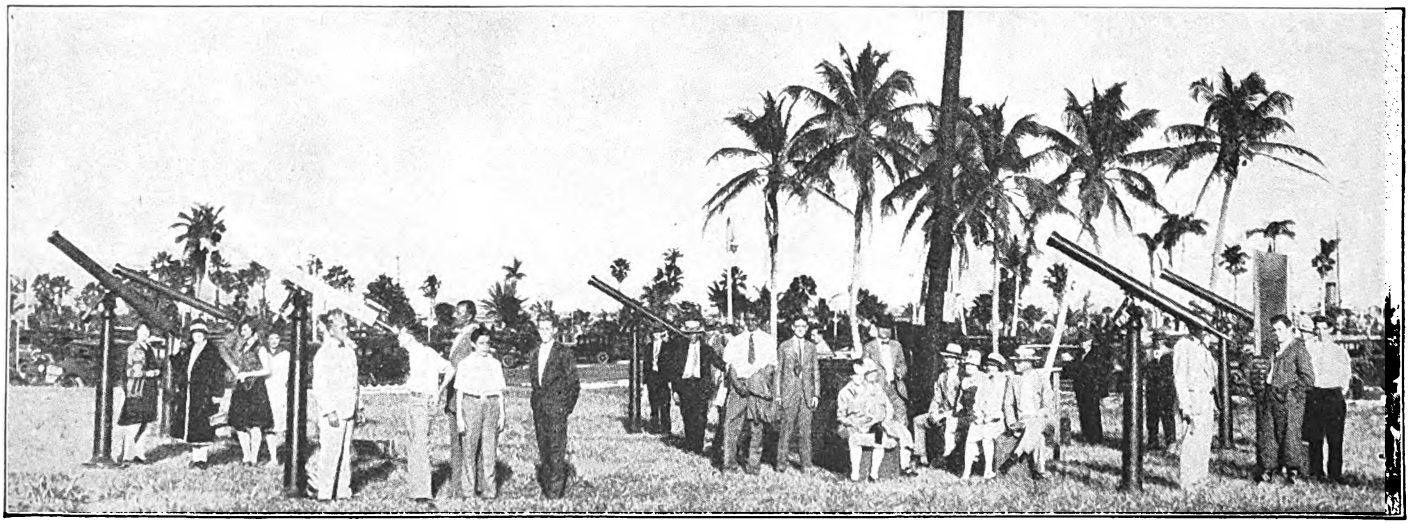
"The phonograph motor is mounted inside the steel stand. The polar angle may be adjusted, without interfering with the gear train.

"The six-inch mirror was ground and finished by me, under difficult circumstances. No basement was available and the work was done in the open air, with the final shadow tests made in an ordinary living room. Temperature troubles were

(*Please turn to page* 177)



The trim Long-Watson telescope



The visiting public at Miami, making use of the unique Southern Cross Observatory

READ WHAT

Prominent Astronomers Say

about

AMATEUR TELESCOPE MAKING

"I BELIEVE it meets a real need, and the SCIENTIFIC AMERICAN is to be congratulated on publishing such a volume." *E. A. Fath, Associate Editor, Popular Astronomy.*

"I CONGRATULATE you on its many improvements and am sure it will attract a large number of real workers into astronomy. You are doing a splendid service for science." *George E. Hale, Hon. Director, Mt. Wilson Observatory.*

"PERHAPS few younger men will feel the same enthusiasm as one who counts more than 60 years of interest in telescopes, but such will surely acquire gratitude for your work with increasing knowledge; they will even learn that if they follow the history of the telescope from the beginning of the 17th Century to our own times, they will have been brought into mental contact with all the great mathematical philosophers of three centuries." *Charles S. Hastings, Prof. Emeritus of Physics, Yale University.*

"I FIND the book is nearly completely perfected and now the best book of its kind ..... Since the August of 1926 there are thousands of mirror workers in Japan. Most of them were young students of teens age, which seems to be somewhat different compared with most American workers." *Prof. K. Nakamura, Astronomical Observatory, Kyoto University, Kyoto, Japan.*

"IT is the only book of its kind known to the reviewer and can be highly recommended as it deals with the subject in a practical way by authors who have actually made the instruments about which they write." *Review in Popular Astronomy.*

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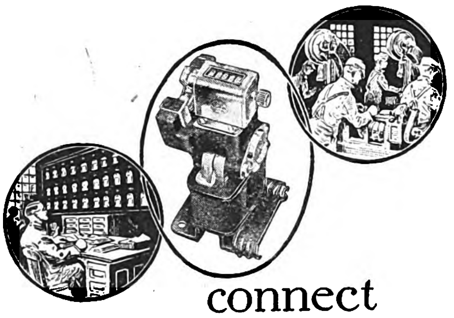

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No waiting for reports from the shop. You get the total of finished products or smallest parts—*as fast as produced.* Wired to you from machines or assembly lines. Registered on the Counter-dial over your desk.

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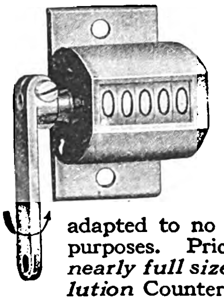

Veeder-Root can supply you with Counters to "count anything on earth." For general machinery, textile machinery, automatic vending machines, business office machines, experimental and development-work. Mechanical and magnetic counters; ask for literature on the lines that interest you.

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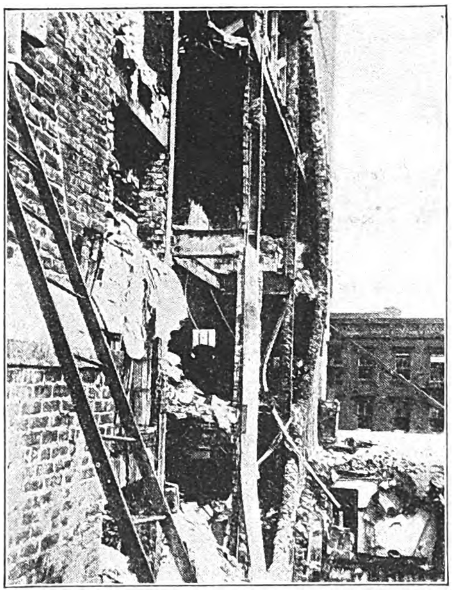
HARTFORD, CONN.

Industries From Atoms

(*Continued from page* 167)

The saving of life, property, and products is vitally related to the conservation of national resources. Although we have made progress in obtaining scientific data on the causes of dust explosions in certain types of industrial plants and in the development of methods for their control and prevention, it is apparent that this problem is extending into many new industries in which the hazard is now being definitely recognized.



The result of another dust explosion followed by a serious fire

The Chemical Engineering Division of the Bureau of Chemistry and Soils is very desirous of continuing to co-operate with the industries and other interested agencies in obtaining further information regarding the dust explosion problem, and of rendering any possible assistance in the development and application of effective methods of prevention and control.

Synthesis of Benzol From Methane

FRANZ FISCHER, distinguished German chemist and Director of the Kaiser Wilhelm Institute for Coal Research, was one of the speakers at the recent Bituminous Coal Conference in Pittsburgh. His paper entitled, "The Formation of Benzol and Other Hydrocarbons by the Action of Heat on Methane" showed that (1) methane can be converted into benzene and other benzene hydrocarbons if it is heated to temperatures of 1000 to 1200 degrees when keeping the heating period shorter than 10 seconds. Under these conditions processes can be carried out under ordinary pressure and catalyzers are unnecessary; (2) conditions can be so adjusted that the chief reaction products consist of benzene hydrocarbons, more than half of which are benzene; and the amount of unsaturated hydrocarbons in the residual gas can be reduced to 4 percent.

More About Chromium Plating Hazards

COMMENTING on an item published in this department in our December issue referring to health hazards in chromium plating and suggested safeguards, Dr. H. S. Riederer, of New Rochelle, New York, very kindly calls the following pertinent information to our attention:

"During a part of my practical experience in technical chemistry, I was connected with a chromate plant and there saw something of the effects of chromic acid and its salts on human tissues. Our greatest troubles were the "chrome sores" on exposed parts of the body. These are often very painful and prevent proper night rest. It occurred to me then that the irritating cause was primarily chemical with the chromic acid radical as the chief offender. Trial quickly showed that the chromic acid radical is easily reduced to chromic hydrate, which is not irritating, even in a sore. Applying a solution of bisulfite of soda to a sore, has this effect. The region of the sore soon becomes less sensitive and the bisulfite solution can be worked into the depths of the sore. Sores which had been several months old and continually creeping, were permanently healed in a week or two and the workman was relieved of pain during the healing. This matter was published in the *Journal of the Society of Chemical Industry* about 1905 or 1906, entitled 'The Treatment of Chrome Sores.'"

Bulk of Asphalt Comes From Petroleum

THE principal source of the asphalt so largely used in the construction of the nation's highways is by many thought to be the famous pitch-lakes of Trinidad, but the fact is that asphalt derived as a product in the refining of petroleum far outranks other asphalts in importance, according to the United States Bureau of Mines, Department of Commerce. The total value of the yearly sales of petroleum asphalts is nearly ten times that of native asphalts and related bitumens.

Very little petroleum asphalt was manufactured before the 20th Century, as the asphaltic materials that were obtained as residuals by refining were of inferior quality. With the rise in production of asphaltic base petroleum in California during the early part of the 20th Century, the discovery of the beneficial results obtained by the use of steam in refining, and the growth of asphalt in public favor as a road-building material, the petroleum asphalt industry was placed on a firm basis and grew rapidly. A further impetus was supplied when Mexican petroleum, which has a high asphalt content, was imported in quantity for the first time.

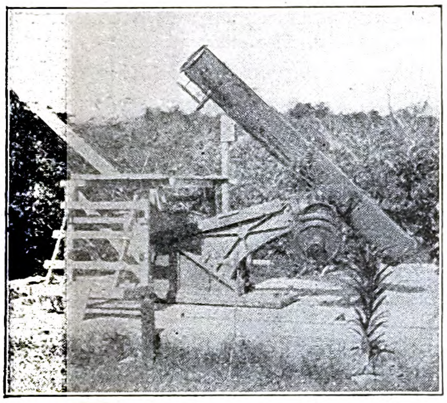
The term "asphalt" is commonly used to denote the various forms of bitumen found in nature or produced by refining. The term includes: Native asphalt, which in the United States is generally associated with other mineral matter, such as limestone and sandstone, and is usually called bituminous rock; the "related bitumens"—a series of natural hydrocarbons, of which only gilsonite, grahamite, ozokerite, and wurtzilite (elaterite) are of commercial importance; and petroleum asphalt, the major class, obtained in the refining of oils of an asphalt base or a mixed asphaltic and paraffin base. Native asphalt of the "pitch lake" type is not found in the United States in sufficient quantities to compete with the celebrated Trinidad and Bermudez Lake deposits, which together suppy nearly all of the asphalt imports of this country.

The Backyard Astronomer

(*Continued from page* 174)

great, but the mirror was brought to a perfect paraboloid and shows very good definition at high powers. The telescope is at Pacific University for student use."

It is interesting to note the wide variety of vocations represented by our list of amateur telescope makers. The description quoted below comes from a physician, Dr. J. J. Byl, of 430 South 13th Street, San Jose, California. Obviously, Dr. Byl is a real enthusiast, else he would not have made two such businesslike telescopes as those shown in the illustration.



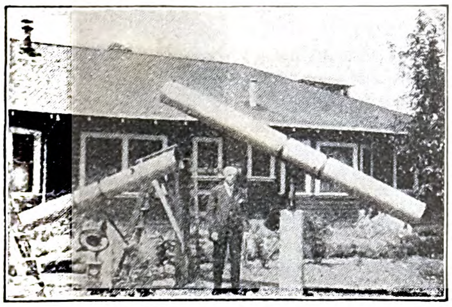
A 12½-inch reflecter by Calver, the celebrated English maker, owned and used by Professor William H. Pickering, at Mandeville, Jamaica, B.W.I. Note low angle of polar axis for 18 degrees north latitude

"In sending you pictures and a brief description of my telescopes," says Dr. Byl, "I believe I have no other motive than to be helpful in stimulating an interest in a useful and noble activity for young and old. In including myself in one of those I have done so only on your command. [Yes, we prefer this.—Ed.]

"I am a retired physician well along in years but have great anticipations of joy in so profound a study as the boundless Universe, and I am sure that my days will never be shortened by a loss of activity or interest in life.

"My ten-inch telescope has done good service for some time, although the silvering has not been by far what it might be. I have not had good success with the Lundin process. After three failures with the 12½ inch speculum, I followed Brashear's method and was surprised with my easy success.

"The tube of the larger instrument is 13 inches by 12 feet and the focus of the speculum is 12 feet, 4½ inches. The material is 16-gage galvanized iron with the edges all butted and soldered and the joints reinforced with bands of the same material. The mountings of the smaller



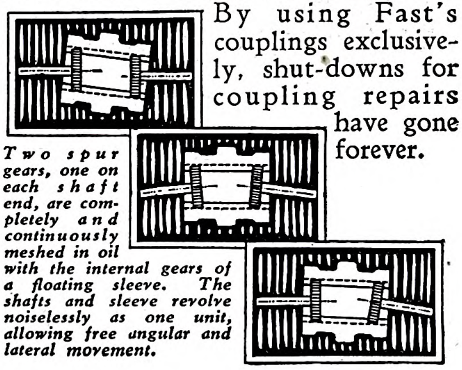
Dr. Byl and his two reflectors

This Book Tells How To Eliminate Coupling Shut-downs

Read what an authority says on how to avoid failure due to fatigue

AS LONG as there is any flexible material between your source of power and your driven machine, you are inevitably faced with the probability of failure and shut-down for repairs. Any flexible coupling built on old practice of using flexible bushings, pins, springs, discs or grids, keeps your plant subject to shut-down when you least expect it.

Since 1920 this has been avoided in thousands of plants. Scores of the country's largest equipment manufacturers have avoided it on machines they sell. By using Fast's couplings exclusively, shut-downs for coupling repairs have gone forever.

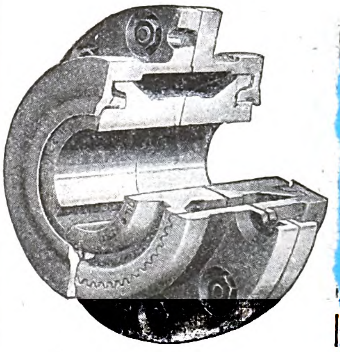


Two spur gears, one on each shaft end, are completely and continuously meshed in oil with the internal gears of a floating sleeve. The shafts and sleeve revolve noiselessly as one unit, allowing free angular and lateral movement.

Purely Mechanical Flexibility

See how simple it is. Mechanical flexibility is used throughout. See the diagram. See the way simple or compound misalignment is taken up by the floating sleeve principle. Instead of relying on flexible materials that would inevitably fail, all misalignment is taken up between the gear faces. Oil, under centrifugal pressure, carries the load.

Today over twenty million horsepower is being transmitted through Fast's couplings, only because coupling users have discovered that Fast's coupling is a permanent piece of transmission machinery, bought once and for all, and not calling for constant replacements and repairs.



For Your Equipment

No matter how complicated your coupling problem is, remember that Fast's couplings are made to meet all conditions, from small pump and blower service up to huge steel mill reversing drives.

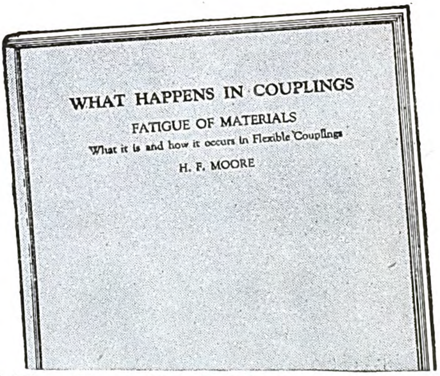
FAST'S
Self-aligning
COUPLING
Without flexible bushings, pins, springs, discs, grids or any other flexible materials.

At first, Fast's couplings went into new installations only. Now engineers and plant superintendents are finding it profitable to change to Fast's couplings at once, and avoid expensive shut-downs before they occur.

Send For Free Book

Do not fail to send for the new book telling how couplings can now be made without flexible materials, and why the use of mechanical flexibility will eliminate coupling failures in your plant.

The full facts will convince you that Fast's coupling solves the costly coupling problem once and for all.



WHAT HAPPENS IN COUPLINGS
FATIGUE OF MATERIALS
What it is and how it occurs in Flexible Couplings
H. F. MOORE

The Science of Flight

The Construction of an Airplane

The Mysteries of the Engine

All explained by one of our foremost aeronautical experts, in explicit and simple language so that anyone can understand. The author has a most unusual and happy faculty of explaining abstruse engineering details, by his long practical and professorial associations in aeronautics.

* * *

IF YOU WANT TO FLY

By Alexander Klemin

Prof. Aeronautics, New York University
Aeronautical Editor, Scientific American

$2.65

one are of shaped steel and pipe; and of the larger one, castings from my own patterns. The shafts are cold-rolled steel selected to fit exactly the inner faces of the Timken ball bearings at both ends of all shafts.

"I wish to call special attention to the compact and strong cradle of steel plate for the tubes, and the pedestal on a base of rejected kitchen tanks which can be had for little or nothing.

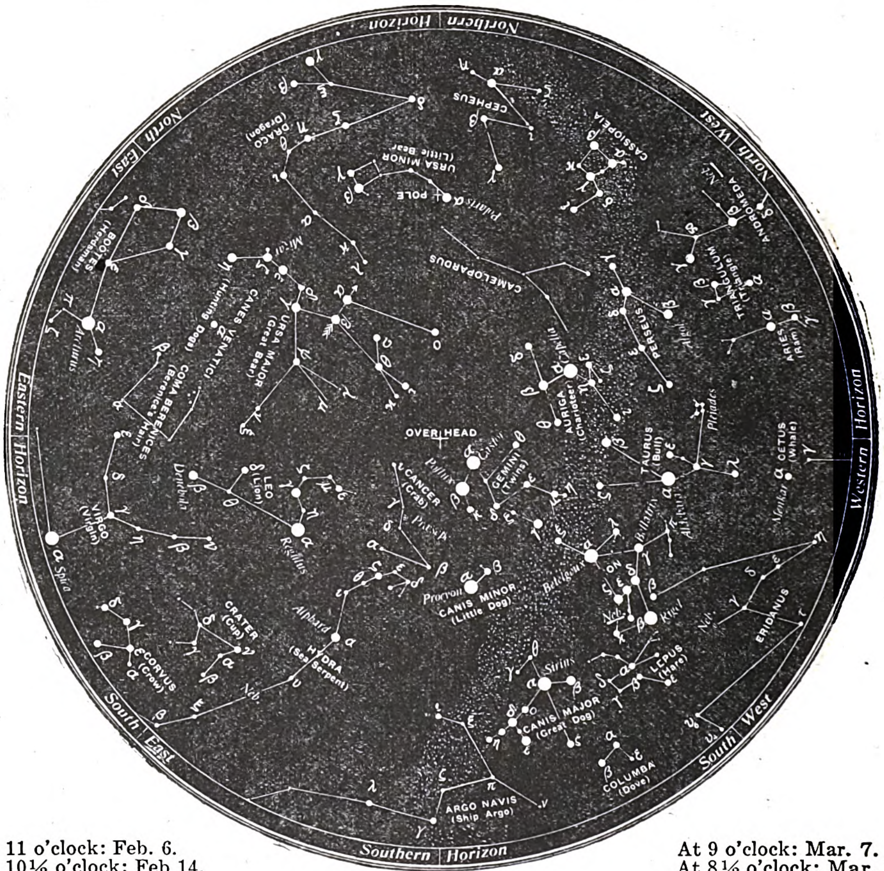
"The smaller instrument can be driven by clockwork. The larger one will have an electric motor drive in which the speed is reduced by three worms and a small pinion on a ring gear, shrunk on a brake drum. The latter serves as a circle also.

"The 2-by-32 inch finder is now made and mounted.

"Invention and machines have since my boyhood been as natural as eating. I do all the work myself and with pleasure, consequently, the cost in money is not great." So writes Dr. Byl.—*The Tel. Ed.*

The Heavens in February

By PROF. HENRY NORRIS RUSSELL, Ph.D.


Northern Horizon
North West
North East
Eastern Horizon
Western Horizon
South East
South West
Southern Horizon
CEPHEUS
CASSIOPEIA
DRACO (Dragon)
URSA MINOR (Little Bear)
POLE
Polaris
CAMELOPARDUS
ANDROMEDA
TRIANGULUM
PERSEUS
Algol
ARIES (Ram)
BOOTES
Arcturus
CANES VENATICI (Hunting Dogs)
URSA MAJOR (Great Bear)
Mizar
COMA BERENICES (Berenice's Hair)
AURIGA (Charioteer)
Capella
OVERHEAD
GEMINI (Twins)
Castor
Pollux
CANCER (Crab)
Praesepe
TAURUS (Bull)
Aldebaran
Pleiades
CETUS (Whale)
Menkar
LEO (Lion)
Denebola
Regulus
VIRGO (Virgin)
Spica
CANIS MINOR (Little Dog)
Procyon
Betelgeuse
ORION
Bellatrix
Rigel
Neb.
ERIDANUS
CRATER (Cup)
CORVUS (Crow)
HYDRA (Sea Serpent)
Alphard
CANIS MAJOR (Great Dog)
Sirius
LEPUS (Hare)
COLUMBA (Dove)
ARGO NAVIS (Ship Argo)

At 11 o'clock: Feb. 6.
At 10½ o'clock: Feb 14.
At 10 o'clock: Feb. 21.

At 9½ o'clock: March 1.

At 9 o'clock: Mar. 7.
At 8½ o'clock: Mar. 15.
At 8 o'clock: Mar. 22.

NIGHT SKY: FEBRUARY AND MARCH

MERCURY is an evening star until the 7th and a morning star afterwards. Toward the end of the month he rises more than an hour before the sun, and should be easy to see.

Venus is an evening star at her greatest apparent distance from the sun (on the 7th) and is very conspicuous. She remains in sight until 9 P.M. and may easily be seen before sunset, or even at noon if the air is really clear. The afternoon of the 13th, when she will be about 8° to the right of moon and nearly at the same altitude, od time to look for her.

ow receding rapidly from the still a prominent object about Capella. He is on the border and Gemini and comes to the out 8 P.M.

an evening star in Aries and after 11 P.M. in the middle of

a morning star in Sagittarius, tween 3 and 4 in the morning. in Pisces and sets near 9 P.M.; while Neptune is in Leo and comes to opposition on the 19th. At this time he is in 10h 9m 16s R. A. and 12° 2′ north declination; which places him 1° 8′ east and 16′ south of the bright star Regulus. This should make it easy to find him with a strong telescope, but a good star map is an almost indispensable aid unless one makes a sketch map of the faint stars lying to the east of Regulus. Once this has been done the planet should easily be picked up by his motion, which is 6s.4 west and 36″ northward per day.

The moon is in her last quarter at 9 A.M. on February 1st; new at 1 P.M. on the 9th; in her first quarter at 7 P.M. on the 16th, and full at 2 P.M. on the 23rd. She is nearest the earth on the 20th and farthest away on the 4th. As she sweeps around the skies she passes by Saturn on the 5th, Mercury on the 8th, Uranus on the 12th, Venus on the 13th, Jupiter on the 15th, Mars on the 18th and Neptune on the 23rd; but none of these conjunctions is apparently close.

Current Bulletin Briefs

(*Continued from page* 172)

Heat Resisting Alloys is a 28-page bulletin containing valuable information concerning the selection, design, and use of metal castings for high temperature service. *Southern Manganese Steel Company, 6600 Ridge Avenue, St. Louis, Missouri.—Gratis.*

Radio

Receiving Sets for Aircraft Beacon and Telephony, Bureau of Standards Research Paper No. 19, deals with the various types of radio receiving sets required on commercial and military aircraft. *Superintendent of Documents, United States Government Printing Office, Washington, D. C.—15 cents.*

Commercial and Government Radio Stations of the United States. This 176-page publication contains a list of the commercial and government land and ship radio stations, aircraft stations, commercial broadcasting stations, radio beacons operated by the Lighthouse Service, and the abbreviations used in radio transmission. *Superintendent of Documents, United States Government Printing Office, Washington, D. C.—15 cents.*

Miscellaneous

Calendar Simplification is a 16-page pamphlet discussing the progress of the campaign to revise the calendar. *International Fixed Calendar League, 1910 Wyoming Avenue, N. W., Washington, D. C.—Gratis.*

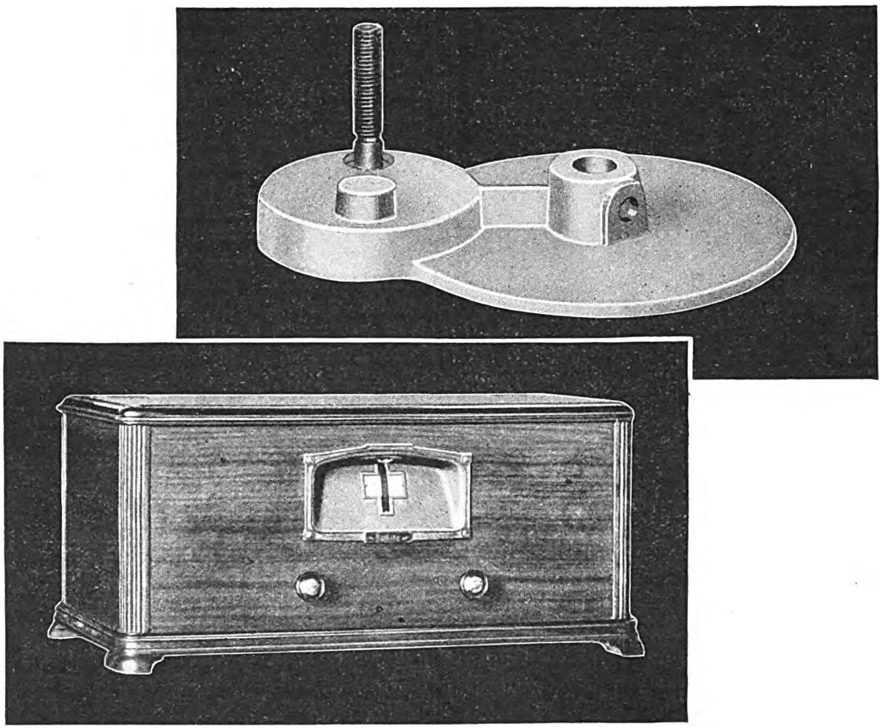
Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

The proposed 13-month calendar has 28 days to the month and an additional fixed annual holiday

Employment for Americans in Latin America, an 18-page pamphlet, has been published for the purpose of presenting the facts concerning both sides of a subject on which unbiased information is scarce. *George J. Eder, Chief, Latin American Section, Division of Regional Information, Department of Commerce, Washington, D. C.—Gratis.*

X-Raying the Earth by Professor Reginald A. Daly, is a reprint from a recent issue of the *Harvard Alumni Bulletin.* This 6-page paper is a very interesting presentation of the attempt of scientists to determine the true nature of the interior of the earth. The vibrations and tremblings of the earth are used to "X ray" the deep interior, for earth-waves are analogous to the familiar waves of sound and light. *We believe copies of this paper will be furnished gratis. Reginald A. Daly, 23 Hawthorn Street, Cambridge, Mass.*

7 OPERATIONS ELIMINATED
. . By Die Casting . .



. . and Costs Greatly Reduced . . .

A MILWAUKEE Die Casting containing a cast-in cadmium plated steel insert has replaced a cast iron counter-weight in the new Balkite radio receivers made by Fansteel Products Co., Inc.

As a result two drilling, one boring, one reaming, one riveting, and one tapping operation are eliminated as is the finishing operation formerly required to prevent rusting. (The die-cast alloy is rust proof.)

Incidentally, the accurate, uniform weight resulting from die casting in this particular case eliminates the necessity of balancing this part when the receiver is assembled.

Worthy of special mention is the fact that though the steel insert is cadmium plated before the casting is made, the die casting process does not injure the cadmium finish in any way.

YOUR PRODUCT and DIE CASTING

May we send you this illustrated, non-technical treatise on die casting—its possibilities and limitations? A request on your business stationery brings it to you.

Perhaps parts of your product can be re-designed for die casting with similar savings and advantages. Milwaukee die casting technicians can help you decide — without cost or obligation.

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MILWAUKEE
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The Scientific American Digest

(*Continued from page* 165)

Byrd and himself in the two sextants.

For several months prior to his departure, Shropshire, upon whose navigating ability the expedition will depend whenever Commander Byrd is not flying, made a series of observations for altitude with the bubble sextant, from the roof of the Hotel Biltmore in New York City, where the expedition had its headquarters. His efforts were directed to working out the shortest method for obtaining exact location. The fastest method, until recently, required 15 minutes, but Shropshire states that he has succeeded in cutting down the time required for obtaining accurate locations, to less than two minutes—76 seconds, to be exact. Rapidity in obtaining accurate position is made necessary by the speed of the airplanes which will be used. By extreme accuracy is meant within one half to three miles of the actual location. Clear perception of the bubble in the sextant, as the sun is brought into coincidence with it, is essential to such findings, in the Antarctic, where the magnetic influence of the earth is greatly magnified.

Widows Most Settled Type of Store Clerk

WIDOWS who are not too young and not too well educated are the most stable type of saleswomen, according to a survey made by C. J. Ho, at a large New York City department store. Generally speaking, women over 30 years old are less likely to shift from one job to another than younger clerks, he shows in reporting his investigation in *Industrial Psychology Monthly.*

In the three months of the survey, single women left the employment of the store less often than married women, and widows least of all. Clerks whose intelligence was just about average put in a longer term of service with the firm than very dull or very bright saleswomen. The stupid apparently find the work too exactingly difficult, whereas the bright clerk grows bored after a few months of dispensing notions or stockings. Clerks who had the benefit of higher education proved more restless than those who finished their studies in the grammar school.—*Science Service.*

Low Temperature Coffee Percolator

ACCORDING to the Coffee Grower's Association, coffee usually reaches the consumer in a "half-manufactured" state. The completion of the manufacturing process must of necessity take place in the kitchen, and we all know that in a great many cases the beverage is ruined in the making.

With that known fact the coffee trade engaged the Massachusetts Institute of Technology to make a research, and advise as to what was necessary to prevent this trouble. It took about two years, and cost about 125,000 dollars.

The net result of a very lengthy report is that coffee should be brewed, if in metal, in one that is not affected by any organic acid. Secondly, coffee should be brewed at a temperature of 185 to 195 degrees. The common practice is 212 degrees, Fahrenheit, or the boiling point.

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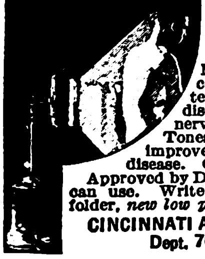

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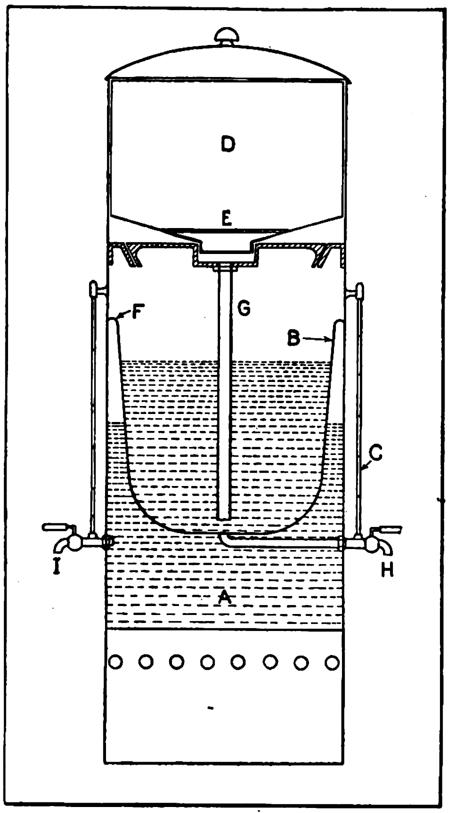
The next step was to produce a foolproof machine that would accomplish this purpose. Therefore a machine was made of pure nickel and Monel metal throughout, with a vitrified china bowl for the coffee container. By means of the apparatus, the brewing takes place at a temperature of 195 degrees, and it is automatic in this respect. The separation of the coffee grounds from the extracted coffee is done by means of a filter paper, which is renewed each time, and eliminates the unsanitary cloth bag.



Large size percolator which brews coffee at a low temperature

Water is allowed to flow into water jacket "A," also into vitrified china crock "B" from pipe connection in the rear in quantity sufficient to make any predetermined quantity of coffee as indicated on glass coffee gage "C." The correct amount of ground coffee is placed in container on top of filter paper "E."

The water in "A" is now heated and made to boil by means of gas, steam coil, or electric heater. When water in "A" boils, steam rises through port "F" until a slight steam pressure has been created.

The steam, not being able to escape, exerts a downward pressure on the water contained in "B." The water in "B" (which is, in fact, like a double boiler or oatmeal cooker) never boils, but is forced by the steam to rise in pipe "G" through filter "E" in contact with the ground coffee on top of the filter. When this contact is made, the temperature is 195 degrees. A two-minute contact of the water and ground coffee at this temperature makes a perfect decoction of coffee.

The heat is then shut off. Instead of being full of water, "B" is full of live steam. When the heat is shut off, the steam immediately condenses, thus creating a vacuum in "B" which draws the coffee back into "B" through the filter very quickly, leaving the coffee grounds practically dry.

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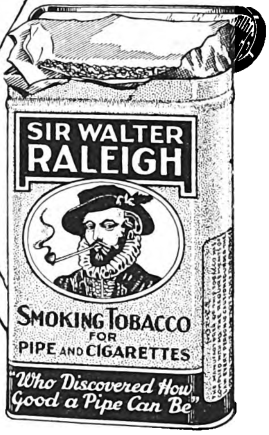
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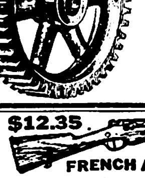

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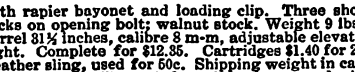

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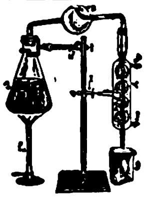

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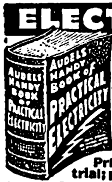

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Learning to Use Our Wings

(*Continued from page* 170)

times the value of the normal loads until the destruction point is reached. By the aid of a transit, deflections at various points along the wing are observed, so that points of weakness are picked out even before the final failure of the structure.

Another exhibit of a scientific character is a gigantic engine test stand. A six cylinder water-cooled engine is mounted on the stand, driving a large two bladed propeller. The engine is supplied with cooling water from a large tank in the back. The whole bed of the engine is pivoted so that the torque of the engine can be weighed. The propeller is surrounded with a circular guard.

One of the most interesting planes seen at Berlin was the Italian hydroplane, *Macchi 52*, which at one time held the world's speed record of 512.776 kilometers per hour (328 miles per hour). The Italian design has some interesting wrinkles for getting speed. The engine is carefully cowled in. The cowling follows even the cylinder heads with smooth curves. A wing radiator is used, as is customary in racers. Owing to the high landing speed, the floats have a sharply pronounced V bottom. The fuselage is filleted into the wing with graceful curves. The tail surfaces blend imperceptibly into the fuselage. The pilot's head almost disappears in the open cockpit, and is protected by a windshield which scarcely interrupts the lines of the body. It is becoming evident that commercial designers will follow racing practice in the near future.

Soviet aviation is said to be progressing very rapidly. Both the construction and the laboratory work of the Soviet engineers are almost on a par with the most advanced aviation countries. At Berlin, the Soviet exhibit of a motor driven sledge attracted particular attention. The sledge is mounted on three skis, with the front one pivoted at the nose of the body, for steering purposes. The three-cylinder air-cooled engine is mounted at the rear of the body and drives a two-bladed propeller which is protected by a guard. The sledge can make over 60 miles an hour, and will undoubtedly prove useful in countries where snow is plentiful, such as Russia or Canada.

Gas Holder as Aviation "Lighthouse"

THE Peoples Gas, Light and Coke Company of Chicago placed in service early in December, a new gas holder (a "tank" to the laity) which is unique in two widely different and superficially unrelated aspects. First, it is a "largest" in the gas industry—being the largest holder ever built anywhere. It holds 20,000,000 cubic feet of gas, and its cost was 1,800,000 dollars. Secondly, it is a "first" in completeness of industrial-structure adaptation to the service of aviation and air navigation.

The new holder is 416 feet high, 283 feet in diameter, and topped with a 70-foot red-light tower.

The body of the holder is painted a sage green. The upper part of it is encircled by alternating 10-foot bands of chrome yellow and black for visibility.

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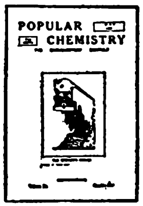

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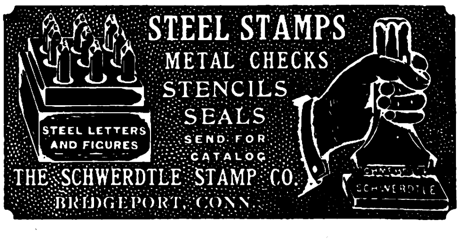

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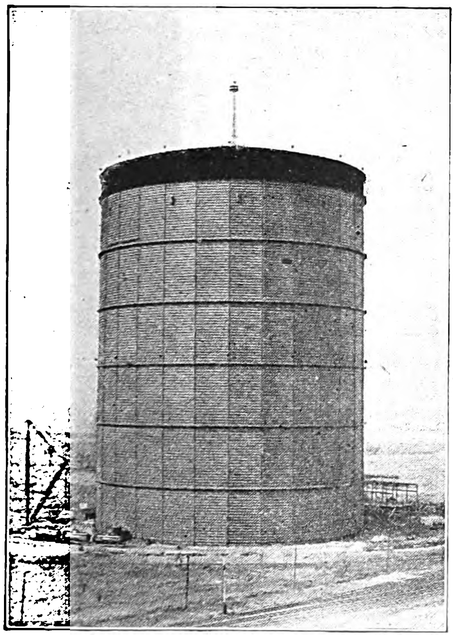
the top of the tower, a band of 14 around the cornice, and another band of 14 lower down.

Across the top of the holder is a broad arrow pointing to the municipal airport, and an inscription: "Chicago Municipal Airport, 2 Miles," in 30-foot letters. Arrow and lettering are in chrome yellow on a black background. The arrow is floodlighted to bring out the "guide post" marking for easy visibility from the air.

An unusual feature of the lighting is that it will be turned on and off automatically, as needed, by an astronomical clock and a photo-electric device controlled by the intensity of light in the surrounding atmosphere.



Gas holder as aerial "lighthouse." Note size of freight cars at left

The gas holder itself is of the modern "waterless" type. Holders of this type, which are rigid structures, are more sightly than the old style of telescopic holder, with its iron girder frame-work.

Some Interesting Books

"AERIAL Photographs," by Dache M. Reeves, published by the Ronald Press, New York, is an authoritative treatise, of interest to officers of every branch of the service who wish to keep informed of the place of aerial photography in scouting, infantry attack, artillery control, and other military operations.

"The World's Wings," by W. Jefferson Davis, has recently been published by Simmons-Boardman, New York. Mr. Davis is an authority on the legal aspects of aviation and was formerly legal adviser to the War Department. His book gives a splendid bird's eye view of aviation in peace and war, in the United States and Europe, interesting to the layman who wishes to get a general perspective of aviation.

"The Zeppelins," by Captain Ernst Lehmann and Howard Mingos, has just been published by J. H. Sears and Company, New York. Captain Lehmann is an experienced constructor and pilot of the great Zeppelin airship factory at Friedrichshafen. Mingos is a skilled and well informed journalist. Between them they have produced an authoritative and vivid history of the development of the airship since its inception.

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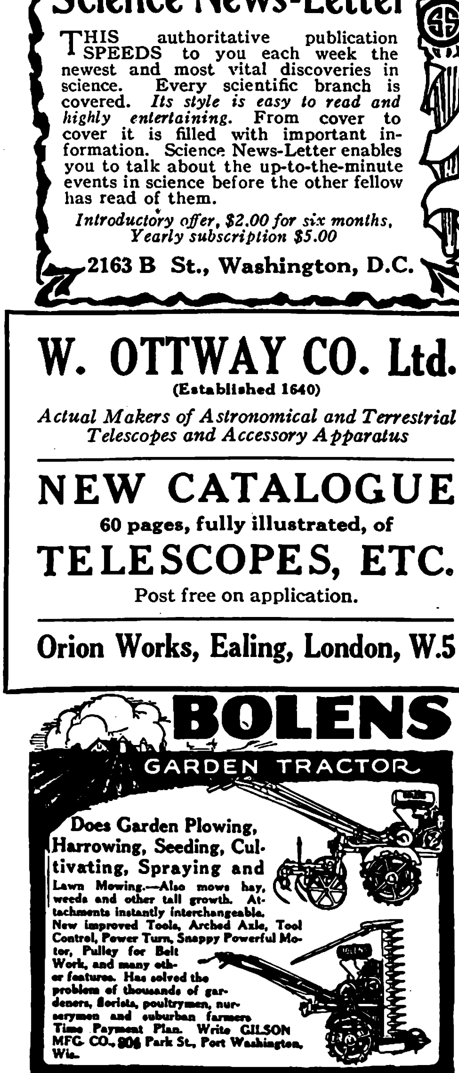

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Are We Slowing Down?

COMMISSIONER of Patents Thomas E. Robertson recently made his annual report to the Secretary of Commerce, showing that applications of all kinds—patents, trademarks, et cetera—received in the fiscal year numbered 116,951, a record number that exceeded the previous high figure of 1927 by 3168. This report is a report of work done; to others is left the task of finding out what, if anything, it signifies.

The significant thing about the figure, to our way of thinking, lies in the fact that 1928 was *not* a record year for patents issued. Apparently more inventors are trying to get patents than ever before but a smaller percentage are getting them. These figures comparing applications for inventions with patents issued seem to tell a story:

Year	*Applications*	*Patents*
1924	76,024	39,963
1925	77,926	45,218
1926	80,682	46,464
1927	84,511	43,244
1928	88,482	41,067

Since 1926 the number of patents has been dropping steadily, although the number of applications has been increasing. The population of the country is greater than ever before, the market for inventions of merit is larger, the number of inventors trying is larger. What, then, can be the matter? Are we running out of ideas?

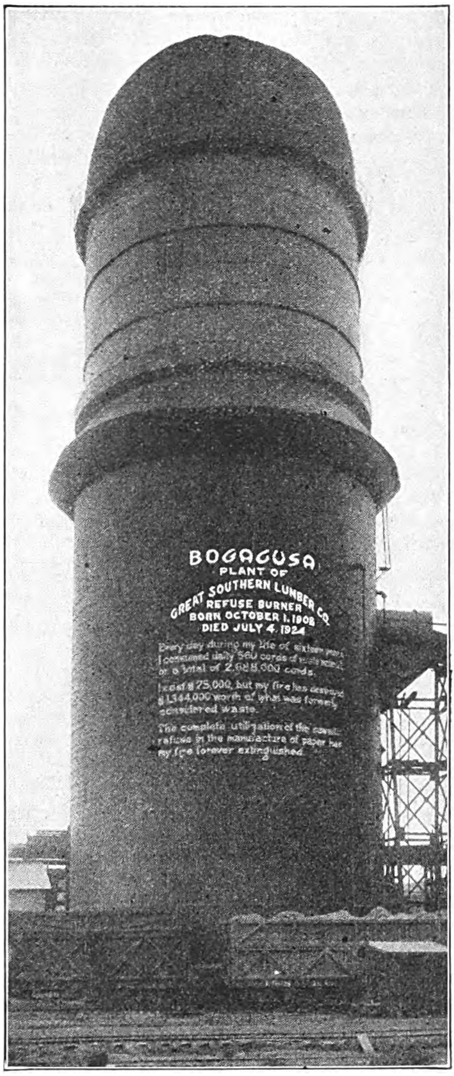
The explanation would seem to lie in the fact that invention is overtaking science. Most patentable inventions are improvements, not basic discoveries. Our inventors have been improving steadily, and the margin of the things remaining to be done within the limits of our knowledge constantly has narrowed.

What we need is more pioneering—someone to push the boundaries of knowledge farther into the unknown—to the end that the great army of lesser inventors can move forward and occupy the new territory with the vast array of minor inventions which add so much to our well-being.

Employers' Shop Rights

THAT an employer may acquire the use of a machine invented by an employee under certain circumstances is generally recognized. As to just how extensive this right is, is a question which sometimes is not so easy to answer. Do, for example, employers' rights cover any machine which may be developed from the first machine, or only for the first machine itself? The case recently brought by the Tin Decorating Company of Baltimore against the Metal Package Corporation and others is a case in point.

The patent in question was obtained by A. W. George for an apparatus for applying hinge pintles to box-part blanks. George was employed by the American Stopper Company in whose plant he had seen the hand process of inserting pintles in tin packages. Believing that an automatic machine might be devised for the work, he constructed in his own home and in his spare time a crude model made of wood whittled out with a penknife. He told A. E. Bruns, formerly employed by the Stopper company that he had a model of the machine. Later Bruns went to the Metal Package Corporation and became its president. He then hired George, who now gave him the model. The Metal Package Corporation then had a machine made by the E. W. Bliss Company, certain changes being made by employees other than George.



Inventive genius turned its attention to using waste in the manufacture of paper bags with such success that the only purpose for this incinerator was as a memorial to its erstwhile wasteful usefulness

Now George left his new employer and applied for a patent, embodying as his own the changes made by the Metal Package Corporation. He knew the company was using the machine it had made, but he neither made a complaint nor requested payment for its continued use until more than two years had elapsed, at which time he sold his patent rights to the Tin Decorating Company and applied for a reissue.

Meantime the Metal Package Corporation constructed three other machines, each of them costing 35,000 dollars and embodying the changes claimed in the George patent. Such machines are necessary in the conduct of their business. When sued for infringement by the new patent owner, the Metal Package Corporation claimed a shop right or implied license to make and use the patented machines. The plaintiff contended that if there was any license at all, it was confined to the use of the Bliss machine installed during George's employment.

"The authorities are in accord that the scope of an implied license is to be determined by the circumstances out of which it arises, including the relation and conduct of the parties in connection with the business in the development of which the employer's money was expended in making the invention operative, and all the other circumstances upon which agreement may be implied or estoppel enforced," said Judge Thacher in the Southern New York District Court.

"To have limited the license to the use of a single machine rather than to the practice of the invention within the reasonable requirements of the master's business would have placed the trade which both the master and the servant sought to develop at the mercy of the owner of the patent, as soon as the business had grown or the art had advanced to such an extent as to make inadequate or obsolete the original mechanical construction which embodied the invention.

"In a rapidly developing art a license to use a particular machine, as distinguished from a license to use the invention, would often be of no practical importance, and of very little value. With continuous mechanical improvement of machinery so often necessary in modern factory practice a license to use an obsolete machine would be of little value, as the record in this case discloses. It is quite absurd to suppose that the parties themselves would have imposed any such limitation, and none such should be presumed.

"The license to be implied should be co-extensive with the employer's business requirements, because the obvious purpose with which invention and investment were made was to satisfy those requirements, and if the scope of the license was to be less than the breadth of this purpose, it was the duty of the employe to say so. No formal granting of a license was necessary. Silence, under all the circumstances, was sufficient to give effect to a license commensurate with the obvious purpose of the parties."

Trademarks in Greece

ON January 1, this year, there went into effect in Greece a new law under which anyone might register in his own name any trademark not already registered in Greece. An American manufacturer whose trademark is duly registered in the United States and who has been exporting his branded goods to Greece for years would have no exclusive rights in the matter. For all legal purposes the Greek registrant would be considered the rightful owner.

The paragraph of the law, which was passed last March reads as follows:

"For the use of trademarks already in use, or which have been used but the utilization of which was not interrupted for more than one year, and which either were not registered, or their registration ceased being in force, a term of one year is granted for them to be registered. After the lapse of this period, the depositor, whosever it may be, is considered as the owner of the same trademark."

The period of grace having elapsed, every American manufacturer selling his goods in Greece under a trademark is advised to register that mark in Greece.

Chinese Irish Lace

IRISH lace is lace made in Ireland, a definition which seems unnecessary. It has been necessary, however, for the Federal Trade Commission to make that definition in order to prohibit four New York importing firms from deceiving the public. These firms had been advertising and selling lace made in China, using some word which tended to imply that the lace had been crocheted in the Emerald Isle.

Lace was first crocheted in Ireland in 1847. Irish lace admittedly is superior to the crocheted laces of other countries and brings a higher price. The lace the New York importers were bringing over from China closely resembled the Irish article in pattern and design. The names by which it was called were such as: Irish, Irish Insertion Shanghai, Irish Square Medallion, Irish Shanghai Picot, Irish Swataw Insertion, Irish Picot, Irish Crochet, Irish Edge, Irish Insertion, Irish Shamrock Edge, Irish Crochet Tatting, Shanghai Irish and Chinese Irish Lace.

The order of the Federal Trade Commission prohibits the companies from "selling, advertising or offering for sale in commerce among the several states of the United States lace made in China or elsewhere than in Ireland under a title, name, or designation which includes the word 'Irish' or any other title, name, or designation suggestive of Ireland as the place of manufacture of such lace."

Idem Sonans

RECENTLY the Cadet Knitting Company applied for registration of the trademark "Narroto" for hosiery. The letters were arranged in the form of a flatiron, with the two O's nestled under the cross arm of the T.

Whether the word was registrable or not seemed to hinge on the final letter. If it should be pronounced like the o in *into*, it was harmless; if on the other hand, it should be pronounced like the o in *toe*, it made the word descriptive. Commissioner Robertson was inclined to believe that there is a rule to the effect that when the letters *to* form the final syllable of a word, it has the long sound as in *grotto*, *pluto* or *canto*.

"Obviously," he says, "applicant has adopted a phonetic spelling of the descriptive term *narrow toe* and hence the doctrine of *idem sonans* applies. The doctrine that merely misspelling a descriptive word does not avoid the objection of descriptiveness is well established."

The case is governed, he finds, by the cases involving *Nextobeer*, *Kanelasses*, *Slo Flo*, *Dyanshine* and *Keepclean*, all of which were denied registration because they were descriptive. He concludes:

"Since it is not denied that the words *narrow toe* would be descriptive, I can draw no other conclusion that that 'Narroto' means the same thing and that registration was therefore properly refused."

European Cartels

INTERNATIONAL trade cartels are becoming so numerous in Europe that some American manufacturers have been getting panicky and Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce, has been impelled to issue a lengthy statement on the subject.

A cartel is a trade or industrial combination in some one commodity. Originally they were domestic, their members in each case being all of the same nationality. Now, however, there has appeared the international cartel, grouping the makers of a common product who operate in various countries. These international cartels have as a rule been formed under German leadership, and, with but few exceptions, have no British or American memberships. It is said that those of our industries which would be affected directly by the European cartels have an annual output valued at more than five billion dollars.

"The main object of the typical international cartel is to control competition and thus avert attempts, by the producers of any nation, to indulge in unwarranted price-cutting or to encroach on the logical selling territories of other countries," says Dr. Klein. "Limitation of production—by assigning definite quotas to the different producing countries—is one of its principal functions. Thus—in the Continental view—overproduction is obviated, or controlled within certain relatively harmless channels. Agreements as to division of markets form another aspect of such organizations. Some of the combinations, as I have said, go to the extent of fixing prices, thus achieving an even more direct and effective restraint.

"From the standpoint of the producers, the international cartel has given some promise of more stabilized trade conditions. But as the movement succeeds in this

Patents Recently Issued

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Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

AIRPLANE-WING STRUCTURE—Made up of a plurality of sections, of different strengths to take care of various loads, the parts being connected to form a substantially integral structure. Patent 1693449. Henry J. Le Pul, Oceanside Ave., Hempstead, L. I., N. Y.

PARACHUTE—Having novel means whereby the flow of air through the device may be regulated to retard the descent and conform to the weight of the person descending. Patent 1693518. John H. Kessler, 37 Burd St., Nyack, N. Y.

Pertaining to Apparel

SHOULDER STRAP—Designed to support women's underclothing, and having an elastic portion which will accommodate the movements of the body, without being uncomfortable, or chafing the wearer. Patent 1687592. Anna Rothstein, 4911 N. Bernard St., Chicago, Ill.

Chemical Processes

METHOD OF MOTH-PROOFING FABRICS—Which consists in first treating the fabric with a neutralized aqueous solution of acid casein, wringing it out, and subsequently treating with an aqueous solution of a salt of a rare earth metal. Patent 1688717. Hilton I. Jones, 1538 Forest Ave., Wilmette, Ill.

Designs

DESIGN FOR A DRESS—Patent 76914. Katherine E. Burns, c/o Franklin Simon Co., 38th St., & 5th Ave., New York, N. Y.

DESIGN FOR A DRESS—Patent 77040. Maude Siegel, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A HAT—Patent 76902. Irwin B. Simon, c/o Simon Millinery Co., 989 Market St., San Francisco, Calif.

DESIGN FOR A DISH OR SIMILAR ARTICLE—Patent 76681. William P. Graham, c/o Graham & Zenger, 104 5th Ave., New York, N.Y.

DESIGN FOR A STOCKING—Patent 76690. Nathaniel Judson, c/o Mock & Judson, 212 5th Ave., New York, N. Y.

DESIGN FOR A COAT — Patent 76663. Katherine E. Burns, c/o Franklin Simon Co., 38th St. & 5th. Ave., New York, N. Y.

DESIGN FOR LACE—The inventor has been granted two patents 76659 and 76660. Ben A. Ball, c/o American Textile Co., Pawtucket, R. I.

DESIGN FOR A CHANDELIER—The inventor has been granted two patents for ornamental designs. 76742 and 76743. Walter J. Fielding, c/o Skinner Hill Co., 114 E. 23rd St., New York, N. Y.

DESIGN FOR A STOCKING—Two patents have been granted to the inventor. 76756 and 76757. Ruby Lefi, c/o Lefi & Co., 303 5th Ave., New York, N. Y.

DESIGN FOR A DRESS—Patent 76824. Mildred C. Schmolze, c/o Franklin Simon Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A DRESS—Patent 76775. Katherine E. Burns, c/o Franklin Simon Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A MIRROR OR SIMILAR ARTICLE—Patent 76818. Edwin B. Langsdorf, Spring & Crosby Sts., New York, N. Y.

DESIGN FOR A TEXTILE FABRIC—Patent 76784. Carl Edlich, c/o Max Kaufmann & Co., 45 Leonard St., New York, N. Y.

DESIGN FOR A HALLOWE'EN CANDY—Patent 76776. Willis W. Cassidy, c/o Sweet Candy Co., Salt Lake City, Utah.

aspect, the other two elements in the economic picture clearly become concerned. Unless the producer groups make some attempt at least, to consult and win the friendly support of consumers, it is quite obvious that the consumers may resort to some corresponding protective device.

"In many respects the cartels seem to afford a better solution of certain vexatious trade problems than could be expected from international political pacts, tariff unions and similar devices. But the industrial and commercial world is still a long way from abandoning its belief in individualism and competition. It is interested, of course, in the newer developments of these cartels and in their contributions toward more orderly trading and production, but it is by no means ready as yet to accept them as the harbingers of a new industrial and commercial revolution."

Rights Must Be Asserted

A PATENT gives you the right to prevent others from making, using or selling your invention. It is a right, however, which you must actively assert; if you neglect for too long a time to protect against someone who you know is infringing, you will lose your right to collect damages from that person or to prevent his further infringement.

This fundamental principle of patent law was made clear recently in the unsuccessful suit brought by the Dwight and Lloyd Sintering Company against John E. Greenawalt and the American Ore Reclamation Company. Action was brought on the patent issued March 17, 1908, for a process of producing a "sinter" or porous coagulate, out of finely pulverized metalliferous ores. The process is of great value and has gone into universal use in the metallurgical arts.

Greenawalt had been concerned with draft-roasting furnaces since 1901 and had built several experimental ones. In 1906 he obtained two patents for a down-draft furnace and in 1910 a plant under contract with him operated for four months in Colorado. This was as much an infringement of Dwight's and Lloyd's patent, as was his later practice, but, although Dwight saw a photograph of the plant, no action was taken.

As a matter of fact Dwight was infringing Greenawalt's patents, and Greenawalt was pressing him about it. In 1910 Dwight paid Greenawalt 5000 dollars for a license under Greenawalt's patents. Since then Greenawalt licensed various steel and iron companies and more than 25 plants have installed the apparatus and the practice has been continuous. Not until October, 1923, did Dwight and Lloyd file their bill. Their exclusive licensee, the American Ore Reclamation Company, intervened as a defendant. The United States District Court for Southern New York held that the accounting was barred by laches. On appeal, Judge Learned Hand, in the Circuit Court, said:

"It is not as if Greenawalt were a recent or sporadic interloper in the field: he was in the business, a by no means infertile inventor, an active and driving competitor. We think that Dwight must be charged with knowledge of what Greenawalt had done and proposed to do for certainly 13 years before the suit was filed.

"Meanwhile Greenawalt had built up a very large business, which he estimated to amount in all to about 300,000 tons a year. It is quite true that this has not been by building his own plants; he has exploited his invention only by granting licenses, but the assurance born of such long inaction is for that reason no less. In the case of any accounting, the result of a decree is never more than to take from the infringer money that he has collected in the past, or to charge him with damages. The disuse of his plant follows only upon an injunction, and, as substantially all the decisions turn upon the right to an accounting, they are as relevant when the infringer has not manufactured as when he has.

"Each year as it passes inevitably builds up a belief, if nothing has been done, that the patentee does not suppose his rights invaded, and, if the time be long enough, the infringer garners the harvest of even the earliest of the six years to which recovery is in any event limited, with just confidence that he will not be disturbed. To allow this reasonable inference to be upset, and his financial life perhaps to be gravely deranged, is thought to be incommensurate with the importance of the patentee's stale claims."

DESIGN FOR A CUFF BUTTON OR THE LIKE—The inventor has been granted two ornamental designs. Patents 76891 and 76892. Frederick C. Rile, 6022 Calumet Ave., Chicago, Ill.

DESIGN FOR A DRESS—The inventor has been granted three patents 77035, 77036 and 77037. Mildred C. Schmolze, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A STATUETTE—Patent 76928. Harrie C. Green, Box 34, Hubbardston, Mass.

DESIGN FOR A COAT—Patent 76981. Elizabeth Carney, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR LACE—The inventor has been granted patents for two ornamental designs, 77003 and 77004. Reginald A. Hollingworth, c/o Am. Textile Co., Pawtucket, R. I.

DESIGN FOR A FIRESIDE GOLF GREEN—Patent 77020. Carl A. Meilicke, 5423 Winthrop Ave., Chicago, Ill.

Electrical Devices

ELECTRIC CONTROL APPARATUS—Whereby sounds of different pitch, such as transmitted by wireless telephony, may be segregated and employed to set in motion through co-operating devices, definite mechanical motions. Patent 1689121. William S. Ferdon, 201 W. 67 St., Kansas City, Mo.

CODE-SENDING APPARATUS—Having a keyboard similar to a typewriter with a separate key for each code character so that a single key depression will transmit the corresponding signal. Patent 1690023. Louis J. Levy, 553 Jersey Ave., Jersey City, N. J.

HEATING DEVICE—An electric heater which is adapted to be secured in place within a storage tank for liquids, for maintaining the water at a predetermined temperature. Patent 1690986. Barnett W. Macy, c/o W. E. Knight, Commercial Clearing Corp., 111 W. Bay St., Jacksonville, Fla.

ELECTRIC CIGAR AND PIPE LIGHTER WITH EXCHANGEABLE INCANDESCENT BODY—The current conducting element being movably located so that contact is established only if the lighter is brought into certain positions, either inclined or upside down. Patent 1691836. Heinz Agatz, c/o Albert Elliot, 246 Friedrick Strasse, Berlin S. W. 48, Germany.

RADIO AERIAL SUPPORT—Including a mast and an adjustable holder which is particularly adapted for attachment to a chimney, for supporting the mast against accidental displacement. Patent 1691864. Carl Wicke, c/o Farmers Loan & Trust Co., 475 5th Ave., New York, N. Y.

INSULATOR-LOCKING DEVICE—For locking insulators used on electric light, power and telephone lines, the device is virtually self-locking when screwed on to the pin, and may be employed with standard pins. Patent 1691964. Ray S. Dickey and Paula Carnahan, c/o P. A. Carnahan, Western Light & Power Co., Salina, Kans.

SWITCH—Which may be installed in an electric iron handle or grip and yieldingly held in closed position by the pressure of the hand, and open when not in use. Patent 1691291. Joseph K. Kahaleohu, 1814 Hampshire St., Quincy, Ill.

CONDUIT BUSHING—Adapted for electrical work, wherein a seal renders the bushing air and water tight, and also serves to lock the bushing so that it will be held under vibration. Patent 1692710. John A. Spahn, c/o Electric Contracting Co., 111 W. 8th St., Wilmington, Del.

Of Interest to Farmers

FROST-PREVENTION APPARATUS—For orchards and vinyards, in which the distribution of the pressure fluid is effected automatically when the temperature surrounding the vegetation approaches freezing point. Patent 1688802 James W. Crowhurst, 4157 Beverley Blvd., Los Angeles, Calif.

41,000,000 Pounds of Snuff

IN 50 years, the production of snuff in the United States has increased from 4,000,000 pounds a year to 41,000,000, according to a recent report of the Department of Agriculture. Estimating that the snuff user consumes four pounds of snuff a year, the figures indicate that approximately one tenth of the population of the United States are snuff users. These users include people from many walks of life; predominant among them are persons in industries where smoking is prohibited, southern laborers, and immigrants from countries where snuff-taking is a national habit.

Says a report prepared by James V. Morrow, tobacco marketing specialist of the Bureau of Agricultural Economics:

"The American Indians were the original users of snuff in the United States. Tobacco was introduced into Europe about the middle of the 16th Century, and was first used in the form of snuff. Physicians of that day praised its medicinal virtues 'for sneezing, consuming, and spending away grosse and slimie humours from the ventricles of the brains.'

"The use of snuff became so popular that Pope Urban VIII in 1624 issued an edict of excommunication against its use during church services, because snuffing and sneezing interrupted the religious ceremonies. Use of snuff spread to England, Scotland and Ireland, and in the 18th Century snuff taking became the fashion, the lords and ladies taking it in pinches and the scullions and cooks in handfuls.

"The early part of the 19th Century witnessed a decline in snuff taking. Smoking gained in favor, and, of course, predominates up to the present time, but the use of snuff is gradually increasing. From 1880 to 1900 the production of snuff in the United States increased from 3,977,228 pounds to 13,805,311 pounds. By 1905, production reached 23,671,078 pounds, and production has increased steadily since then, the production for 1928 being estimated at 41,451,577 pounds."

It is entirely within the bounds of possibility that in time snuff may supplant cigarettes as our most widespread "bad" habit. Whether it does or not is a matter of comparative profits. Advertising men probably could put it over in time.

Windshield for Grain Harvester—Designed to protect the cut grain from the action of the wind blowing across the harvester, and permit the grain to fall evenly on the binder. Patent 1690966. George Chaney, c/o Albert R. Redman, Doniphan, Neb.

Of General Interest

Means for Displaying Samples—Of units such as bricks, so that an architect or builder may assemble in miniature a facsimile of a fireplace, or other architectural assemblage for the approval of a prospective customer. Patent 1688249. Bernard F. Stenz, c/o Simplex Sampling Association, 11th Ave & 25th St., New York, N. Y.

Broom-Handle Brace—A detachable and adjustable connection for push broom handles, rigidly supporting the handle and relieving the major portion of the strain, in the case of long brooms. Patent 1689109. Richard R. Brock, 806 Quincy St., Brooklyn, N. Y.

Webbing Support for Upholstery—Which will resist the tendency of strains on the webbing from pulling out the tacks which secure the webbing to the furniture frame. Patent 1689100. Kegham Balikjian, 26 Homestead Park, Newark, N. J.

Hinge and Compact Holder for Vanity Cases—Provided with a form of ejector which assists in normally holding the compact in the vanity case while permitting a pull to cause the compacts removal. Patent 1690017. William G. Kendall, 118 Market St., Newark, N. J.

Safety Device for Transporting Fragile Articles—Such as X-ray, violet-ray, mercury arc vacuum tubes, and large incandescent lamps, whereby means are provided to compensate for vertical shocks and jars incident to travel. Patent 1689588. Walter J. Hoy, 4515 48th St., Woodside, L. I., N. Y.

Liquid Container—Which affords facilities for the storage and handling of liquids ordinarily used in cooking, such as oils, and greases, in a convenient and sanitary manner. Patent 1690035. Augustine G. O'Neill and Clarence M. Jones, c/o A. G. O'Neill, Tulsa Tribune, Tulsa, Okla.

Float Ball—For the valve control of flush tanks, formed of glass and having the screw and socket connection of a standard electric bulb type. Patent 1690057. Paul H. Coleman, Box 16, Lynch, Ky.

Ice-Cream Cone—Having a double wall, with a filling of sweetened cream, or other confection between the walls, which will render the cone more desirable and tasty. Patent 1690984. Fred W. Lane and Kenneth M. Anderson, 4334 Edgewood Ave., Oakland, Calif.

Tensioning Device for Clotheslines—Adapted to be connected with the opposite ends of a line in conjunction with the usual pulleys, for protecting the line against breaking due to wetting and shrinkage. Patent 1690957. Vincent P. Tommins, 60 Glenwood Ave., Jersey City, N. J.

Binder Post—For loose leaf binders, being longitudinally compressible for compressing a large number of sheets, but after filling is automatically locked against further extension or disassembling. Patent 1690456. Harold T. Payne and Forrest R. Young, P.O. Box 851, Quincy, Cal.

Window Valance—A suspended valance having a shaped bottom edge, and strips attached thereto, for uniformly weighting the same, to prevent the lower border curling. Patent 1690298. Frank E. Hood, Janet E. Hood and Alexander G. Morrison, c/o Artcraft Valance Mfg. Co., 1919 2nd Ave., Seattle, Wash.

Drawing Board—Having releasable bolts, whereby a sheet of paper may be readily held in its proper position relative to the edge of the board. Patent 1688516. Charles E. Barker, 1938 Fell St., San Francisco, Calif.

Process for Manufacturing Plywoods—And the removal of defective portions from the upper ply, by cutting out circles and plugging with slightly larger disks securely held in place. Patent 1689705. Fletcher L. Walker, Westwood, Calif.

Container with Cover-Lifting Auxiliaries—Having a cap with legs, sufficient space being provided between the legs to permit the fingers to grip the cap for removing it from the supporting surface. Patent 1690479. Charles J. I. Devlin, 224 Stanyan St., San Francisco, Calif.

Place Indicator for Tables—Especially designed for use on the dining tables of restaurants, hotels and other public eating places, for the ready identification of the various guests. Patent 1692742. Charles F. Jacobs, 279 Park Ave., Brooklyn, N. Y.

Display Stand—Of cardboard or the like, wherein the parts are so cut that they may be folded and interlocked to make a triangular support for receiving an article. Patent 1692748. Edwin A. Locke, Jr., c/o Nevins Church Press, 250 Park Ave., New York, N. Y.

Snap Fastener—Particularly constructed not to tear out of loosely woven fabrics, or other flexible material, formed with male and female members for clamping the fabric. Patent 1692701. Lues Reiter and Allan B. Colby, c/o Rau Fastener Co., 102 Westfield St., Providence, R. I.

Dining Chair—Adapted for use in lunch rooms, wherein the right hand corner of the seat is cut away to accommodate the leg of the diner under the food supporting arm. Patent 1693512. Samuel Jaffe, R.R. 2, Box 6, Memphis, Tenn.

Window Construction—Consisting of three sashes, a regular window, a storm sash, and one serving as a screen, all of which may be slid laterally into a recess in the wall. Patent 1693551. Frank X. Graser, John St., Lindenhurst, L. I., N. Y.

Hardware and Tools

Fence Post—Having a device for fastening wire strands to the post, wherein the strand is received in a slot and held by a V-shaped plug engaging the opening. Patent 1689610. Christian Winter, Oskaloosa, Iowa.

Joint Construction—For use on cast iron pipe, embodying an elastic ring which is all the more effectively sealed when subjected to the pressure of liquids or gases. Patent 1690047. Fred C. Armbruster, c/o Southwestern Pipe Joint & Engineering Co., 1108 No. 5th St., Birmingham, Ala.

Metal Lath—Which though lighter in construction than the ordinary metal lath, will resist bending and pressure to a greater extent, and will waste less plaster. Patent 1690450. John H. Killion, 1630 Prairie Ave., Chicago, Ill.

Nail Setter—Adapted to receive and move nails, one at a time to setting position with one hand, while the other is free to drive the nails with a hammer. Patent 1690987. Edward F. Malouf, 325 "D" St., Marysville, Calif.

Window-Sash Holder—Including a strip adapted to be secured vertically on a window frame, and a lateral member adapted to bind against the strip for supporting the sash. Patent 1692731. Anton M. Gunderson, c/o H. J. Rogers, 4929 No. Kailon Ave., Chicago, Ill.

Heating and Lighting

Carbide Lamp—A compact lamp of the acetylene gas type, for miners, in which the filtering material is reduced to a minimum, and functioning parts are easily accessible. Patent 1693463. Walter Prockter, Box 1277, Huntington, W. Va.

Oil Burner—In which the regulation of the flow of air automatically regulates the flow of fuel, thereby forming a perfect mixture with either low or high flame. Patent 1688538. George A. Fiscalini, San Luis Obispo, Calif.

Machines and Mechanical Devices

Pump Valve—Having a guide for maintaining the valve properly centered, the valve seat being sheared off at an acute angle to prevent the collection of foreign matter. Patent 1692795. Leslie B. Clifford, 9 Webber Place, Texarkana, Arkansas.

Air and Gas Cleaner—For use with air ventilating systems or gas plants, whereby the gas or air is directed through a tortuous path containing a bath for washing the fluid. Patent 1691971. Charles S. Hansard and Archie E. Netzel, Box 364, Avant, Okla.

Automatic Brake Operator for Incline Hoists—May be applied to any controller for hoisting engines, but particularly in conjunction with a standard safety device for mine hoists, in raising and lowering cars. Patent 1687621. Henry H. Logan, 6107 Newburg, Norwood Park, Ill.

Bearing Bushing—Comprising a pair of arc-shaped sections with straight slots in the end, guide keys fitting into the slots, and shims for spacing the sections apart. Patent 1693333. Dwight O. Barrett, R. F. D. No. 4 Springfield, Ohio.

Cutting Device—Adapted to be associated with a box sealing machine for cutting predetermined lengths of glued paper and automatically sealing the loose edges of a box. Patent 1689110. Walter W. Brust, c/o Sun Lumber Co., Weston, W. Va.

Art of Making Motion Pictures—In which only a portion is represented in full natural size, while other parts are at a different scale, but so united as to obtain a natural result. Patent 1690039. Eugene Schufftan, c/o Aktien-Gesellschaft fur Spiegeltechink, Berlin, S.W. 68, Lindenster 32-34, Germany.

Cleaner for Filtering Elements—Which includes a shaft rotatably and slidably fitted into the filter, whereby the solids are removed and deposited into a sludge chamber. Patent 1689277. Charles St. C. Burns, c/o F. Kay, 435 5th St., Port Arthur, Texas.

Nut-Cracking Machine—Which will effectually crack the shells of the nuts and separate the shells from the meats without affecting or breaking the meats. Patent 1688966. Hiram H. Hill, 1520 Normal St., Chico, Calif.

Babbitting Machine—Which greatly facilitates babbitting operations, and eliminates pits and flaws in rebabbitting the connecting rod and main bearings of automobiles. Patent 1690992. Thomas H. Orr, c/o Orr's Machine Shop, 424 W. 5 St., Okmulgee, Okla.

Automatic Gate-Controlling Device—Which may be opened by the impact of a vehicle driven against it, the closing movement being checked by the operation of a governor. Patent 1690972. Louise J. Goehrig, Wishek, N. D.

Pumping Rig—Which is strong, durable and rigid, yet may be readily set up and taken down so that the rig may be used over and over again. Patent 1690955. Gilbert Stoufflet, Box 1148, Goose Creek, Texas.

Dispensing Container—For dispensing semi-fluids, whereby the slight turn of a lever will cause a plunger within the container to force the fluid from a restricted opening. Patent 1691861. Harry S. Stout, 2 Willow Glen Drive, Huntington, W. Va.

Gear Teeth—Designed for heavy duty gears, having pinions of low tooth numbers which will have the same tooth pressure and duration of contact as ordinary pinions having many more teeth. Patent 1690931. Sigar D. A. S. Hammar, c/o F. G. Carter, 75 West St., New York, N. Y.

Camera—Having the general appearance of an automatic pistol, and operating automatically by actuating a trigger, a plurality of exposures being made in rapid succession. Patent 1690292. Patrick P. Grosso, 1542 East 35th St., Brooklyn, N. Y.

Machine for Digging Pit Silos and Cisterns—Including a tractor, a series of digging disks, means for varying the digging action, and an elevator, all traveling in sequence through a circular path about a common axis. Patent 1691809. Carl H. Huenefeld and George Campbell, Aurora, Neb.

Filter—Wherein the operation is carried out under pressure without interruption, by virtue of the fact that the separated solids, which tend to retard filtration, are automatically discharged. Patent 1691867. Charles St. C. Burns, c/o F. Kay, 435 5th St., Port Arthur, Texas.

Apparatus for Cutting Cheese or the Like—Comprising a member mounted to swing up and down, and a cutter movably mounted on the member for cutting the upper and underside of the cheese. Patent 1690951. Emil F. Schedwin, c/o Stockholm Patentbyra 7 Vasagatan, Stockholm, Sweden.

Telescopic Hose Coupling—For use in connection with gasoline dispensing apparatus, the lower section, carrying the nozzle, telescoping over the upper section, and maintaining substantially a straight line. Patent 1691816. William H. Klyce, c/o Flint Structural Steel Co., Flint, Mich.

Gasoline Strainer and Lint Catcher—Which is removably mounted on the feed pipe of a tank for straining the gasoline, catching the floating lint, and preventing the clogging of the feed pipe. Patent 1690207. Frank C. Reed, Oregon City, Oregon.

Dish Washer and Dryer—Whereby dishes, cups and glassware may be washed, rinsed and dried, and divers other articles may be scoured and burnished with a minimum of labor. Patent 1687458. William H. Lancelot and James A. Starrak, c/oW. H. Lancelot, Room 318, Agricultural Hall, Ames, Iowa.

Nut-Cracking Machine—In which the crusher bar acts with a yielding pressure and permits the cracking of a plurality of different sized nuts without breaking the kernels. Patent 1693493. Eber H. Patton, Longwood, Mississippi.

Stitch and Method of Forming the Same—Whereby a loose appearing looped formation simulating hand knitting is presented, and whereby a special knit structure may be provided for a part, or all of the garment. Patent 1693439. Albin F. Goetze, c/o Morgan Knitting Mills, 577 So. 10th St., Newark, N. J.

Screw or Worm Propeller for the Propulsion of All Kinds of Craft for Use in Water or Air—In which stepped blades are used to reduce the skin friction and enable the blades to turn faster with the same power without reducing the vacuum effect. Patent 1688639. John K. Larson, c/o Studebaker Garage, Vancouver, Wash.

Apparatus for Dehydrating Tar—By utilizing a steam jet which atomizes the tar emulsion, carrying off the water and allowing the tar to fall by gravity to the point of accumulation. Patent 1693549. Roger Grilly, c/o Interstate Equipment Co., 25 Church St., New York, N. Y.

Dispensing Cabinet—Particularly adapted to hold in bulk and dispense separately articles of a cylindrical nature such as the sanitary paper straws used in drinking various beverages. Patent 1693458. Benjamin G. Patterson, 1835 W. 14th St., Oklahoma City, Okla.

Medical and Surgical Devices

Obstetrical Instrument—Embodying a pair of separable handles and a flexible loop, which after being correctly positioned about the infant's head, may be maintained under tension and manipulated with one hand. Patent 1690942. Edwin O'Dell, Central City.

Sanitary Seat for Invalid Chairs—In which the central portion of the seat is hinged, swingable into open position, and then may be moved laterally away from the opening. Patent 1691620. Cecelia C. Wilson, 548 31st St., Oakland, Calif.

Prime Movers and Their Accessories

Carburetor—Wherein the fuel level may be maintained for eliminating irregular action when the engine is abruptly tilted as the result of travel over rough roads. Patent 1690962. Herbert W. Allen, c/o R. J. Cross, Laboratory Pro. Co., Mason, Mich.

Attachment for Spark Plugs—Which can be readily applied to plugs of different sizes and types, the spark gaps being automatically increased or decreased with the temperature changes of the engine. Patent 1689707. David L. Winters, 852 Hyperion Ave., Los Angeles, Calif.

Internal - Combustion Engine — Which eliminates the use of the usual poppet valves, having a rotary valve mechanism, and means whereby the valves and operating mechanism are automatically lubricated. Patent 1689689. Chester G. Ross, P. O. Box 383, Glendale, Calif.

Internal-Combustion Engine—Which will insure a thorough exhaustion of the products of combustion, and prevent the incoming charge from mixing with the old, thus securing a maximum from the fuel. Patent 1692730. Emil C. Gundelach, 425 Main St., New Rochelle, N. Y.

Air Cleaner—For use in removing dust, dirt and any other foreign matter from the air to be drawn into the carbureter of an internal combustion engine. Patent 1693479. Harry A. Edgar, Luverne, Minnesota.

Railways and Their Accessories

Automatic Train Control—Which will permit a train to run backwards, or against current of traffic, without coming into contact with more than one means employed for actuating the control. Patent 1689738. David C. Meara, 1731 8th Ave., Oakland, Calif.

Locomotive Tender—Which may be loaded in the ordinary way and the danger of coal falling from the side eliminated by means of hinged retaining members. Patent 1691381. Frederick Darby, 1413 E. 68th St., Chicago, Ill.

Rail Joint—Which will not only firmly couple two rail ends together against lateral displacement, but will prevent depression of the ends as cars pass from one rail to another. Patent 1692254. Charles K. Freer, Cardinal Hotel, Madison, Wis.

Pertaining to Recreation

Bow and Arrow—A unique construction, in which the bow shaft is rigid and the bow string elastic, and the arrow is propelled through an opening in the shaft. Patent 1689141. Henry B. Keller, 1716 Newkirk St., Philadelphia, Pa.

Swimming Device—On which an uninitiated operator may support, propel and steer himself on the water, the device is foldable for storage, and adjustable for the height of the user. Patent 1692753. Christian Meyer, 8510 Grand St., Elmhurst, L. I., N. Y.

Game Apparatus—For golf-putting practice, consisting of a plate with pockets arranged at diverse angles, some with passageways constituting hazards, so that the putting must be done with accuracy. Patent 1693474. Frederick L. Burt, 56 Highwood Terrace, Weehawken, N. J.

Pertaining to Vehicles

Warning Signal for Pneumatic Tires—In the form of a colored flap, attached to the outer side of the tire, operable as the air escapes from the tire to attract the driver's attention. Patent 1687761. Waldo F. Hahn, Box 612, Tampa, Fla.

Shock Absorber—Of the hydraulic type, in which the by-pass has an adjustable fluid regulating member which may be set from the exterior of the casing. Patent 1687620. Henry H. Logan, 6107 Newburg, Norwood Park, Ill.

Folding License Plate—A theft preventing device, to be easily removed by the owner, a car operated without a license being quickly noticable by the police as driven by an unauthorized person. Patent 1689140. Herman Jaschun, 124 Ft. George Ave., Apt. 7C, Brooklyn, N. Y.

Hand Truck—Wherein a tiltable lifting frame is elevated by foot operated mechanism, after picking up a bale, or other object, for dumping or stacking the same. Patent 1689156. Earl Ruffner, 2411 Buchanan St., Wichita Falls, Texas.

Bassinet—Which is particularly adapted for use in motor-cars, and will comfortably hold an infant cushioned from the shocks and jars incident to normal travel. Patent 1689091. Homer S. Watt, c/o Gordon Motor Crib Co., Port Chester, N. Y.

Dump Body—Which may be operated manually from the driver's seat on a wagon, without gears, cylinders or other complicated parts involving the use of power from the vehicle. Patent 1690045. Frank R. Allen and Henry M. Champion, c/o F. R. Allen, Ark. Natural Gas Bldg., Pine Bluff, Ark.

Process of Making Radiator Cores—For use on automobiles, whereby tubular members may be provided with two rows of fins mounted in a spiral arrangement without wasting any material. Patent 1689568. Benjamin H. Wade, 2341 Cottage Grove Ave., Chicago, Ill.

Grease-Measuring Device—Which is particularly useful for measuring the amount of grease which is dispensed in applying it to automobiles, and may be adjusted to deliver any desired quantity. Patent 1688505. Jacob C. Mulder, 6 Eaton Court, Watsonville, Calif.

Traffic Signal—A combination of electrically and mechanically operated means for signalling to approaching or following traffic that a turn or stop is contemplated by the operator. Patent 1690971. Judson B. Freidah, 1 Silvern Terrace, Washington Heights, New York, N. Y.

Trailer Hoist and Coupler—Which may be readily manipulated by the driver of a tractor for raising and lowering the front end of the trailer, and for connecting and disconnecting the trailer. Patent 17124 (Reissue) William Mayer, 47 Gowne St., Forest Hills, L. I., N. Y.

Truck Body—A multiple deck body, the frame of which is of open work steel made up of T-beams, providing little lodgment for dirt, and easily cleaned. Patent 1691859. Fred Schelben, c/o Greenville Boiler & Machine Works, Greenville, Miss.

Pedal Holder—For use in automobile shops and garages, for the purpose of holding either the clutch or brake pedal in depressed position, so that adjustments may be made. Patent 1691822. Louis W. Lindmeyer, 131 W. Cooper St., Butte, Mont.

Ventilating Device—For vehicle windows, having a baffle extending downwardly in front of the upper edge, permitting ventilation when the window is slightly lowered, without rain or strong wind blowing in. Patent 1693497. Ralph R. Russell and John S. White, 312 So. 4th St., Paducah, Ky.

Vehicle Spring Tire—Adapted for disposition within a tire casing, eliminating a pneumatic tube, comprising a plurality of cooperative elements, any one of which may be readily replaced. Patent 1692711. Litch J. Swartz, Box 94, Wenatchee, Wash.

Rabbit-Carrying Truck for Greyhound Racing—Having means for supporting a lure such as an imitation rabbit, which will be more reliable in operation in its movements from luring to non-luring position. Patent 1692736. George W. Heintz, R.F.D. 3, Hamilton, Ohio.

Signaling Device—An electric lamp, the cord of which is wound upon a spring-operated drum within convenient reach of the driver who may extend the lamp for signaling. Patent 1691400. Malcolm E. Mitchell, 1209 Park St., Alameda, Calif.

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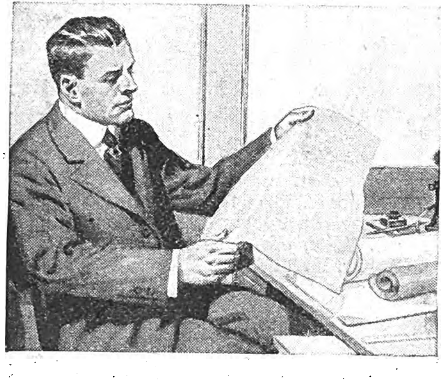

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SPECIAL AVIATION ISSUE

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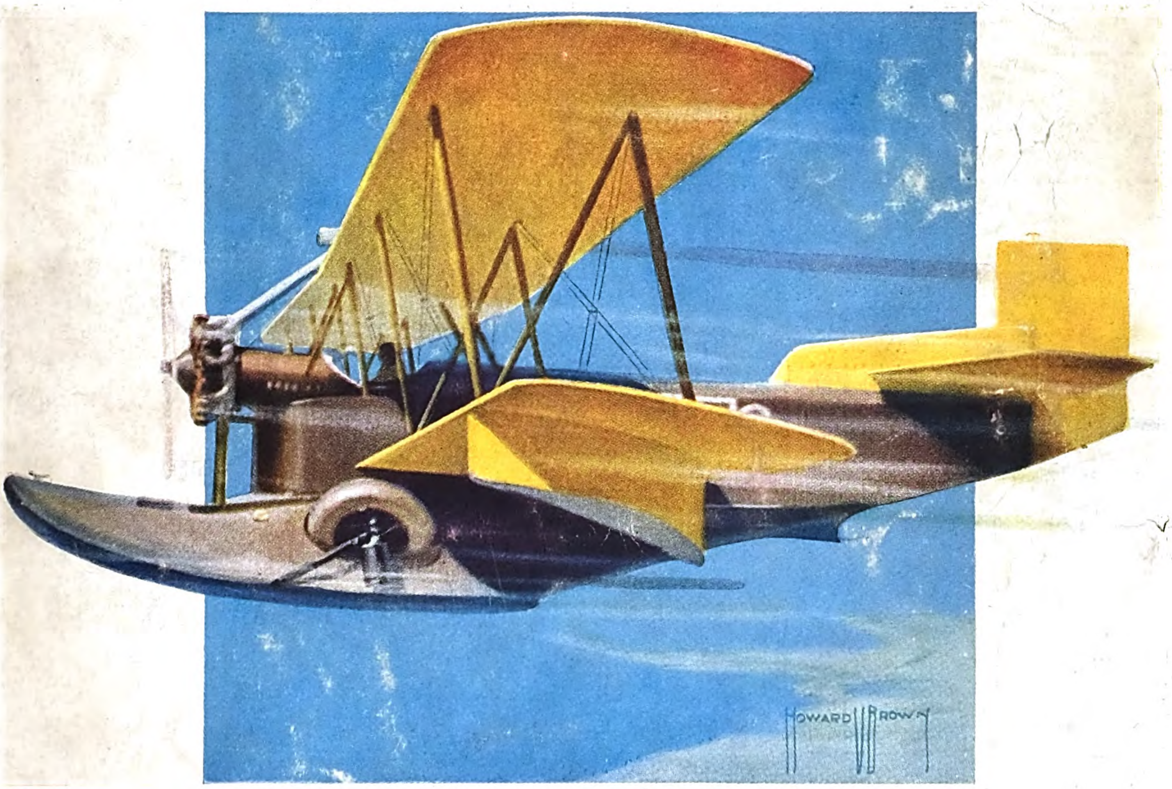

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HOW TO BUILD A GLIDER

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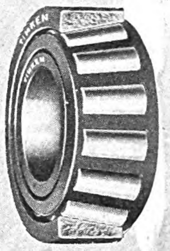
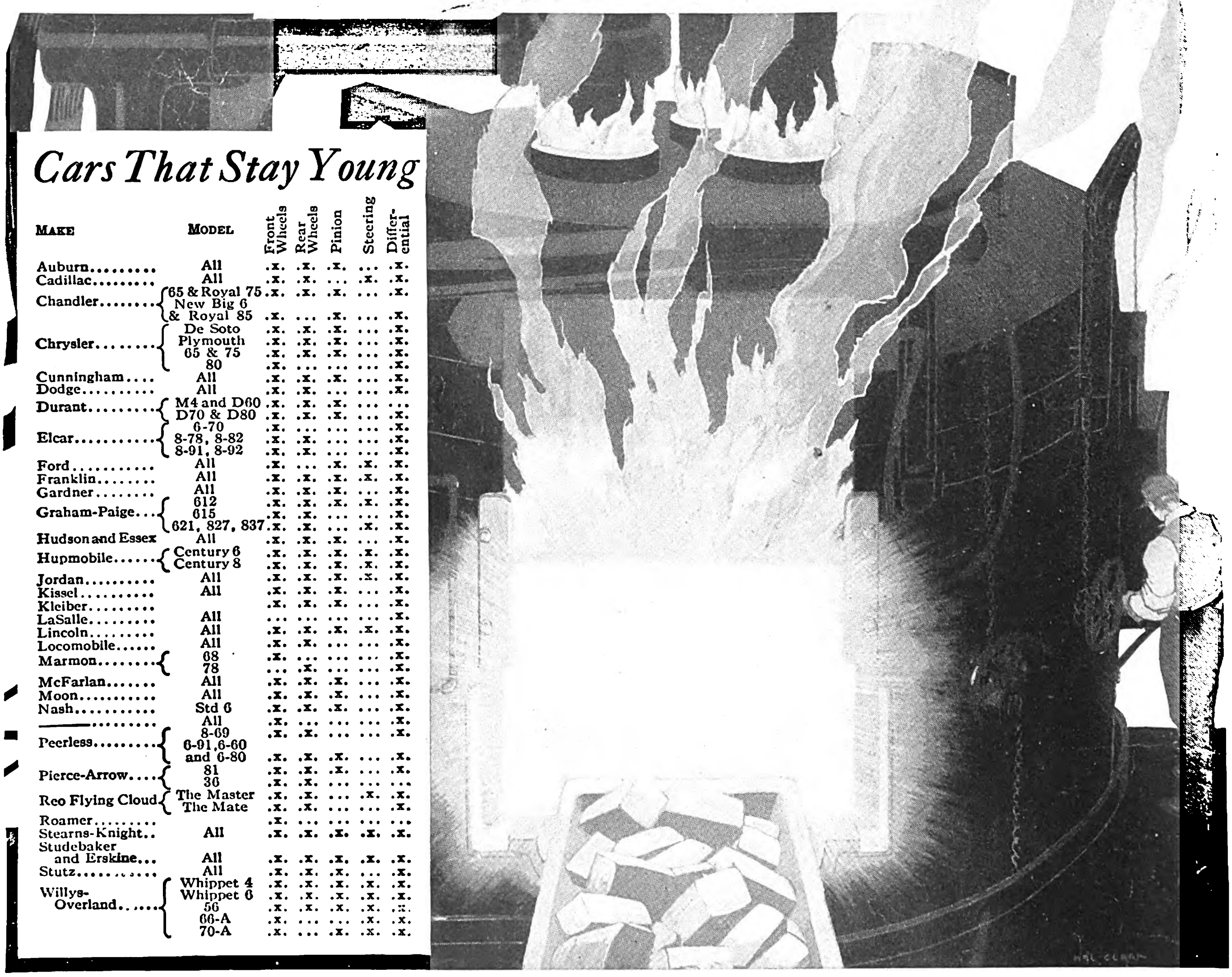




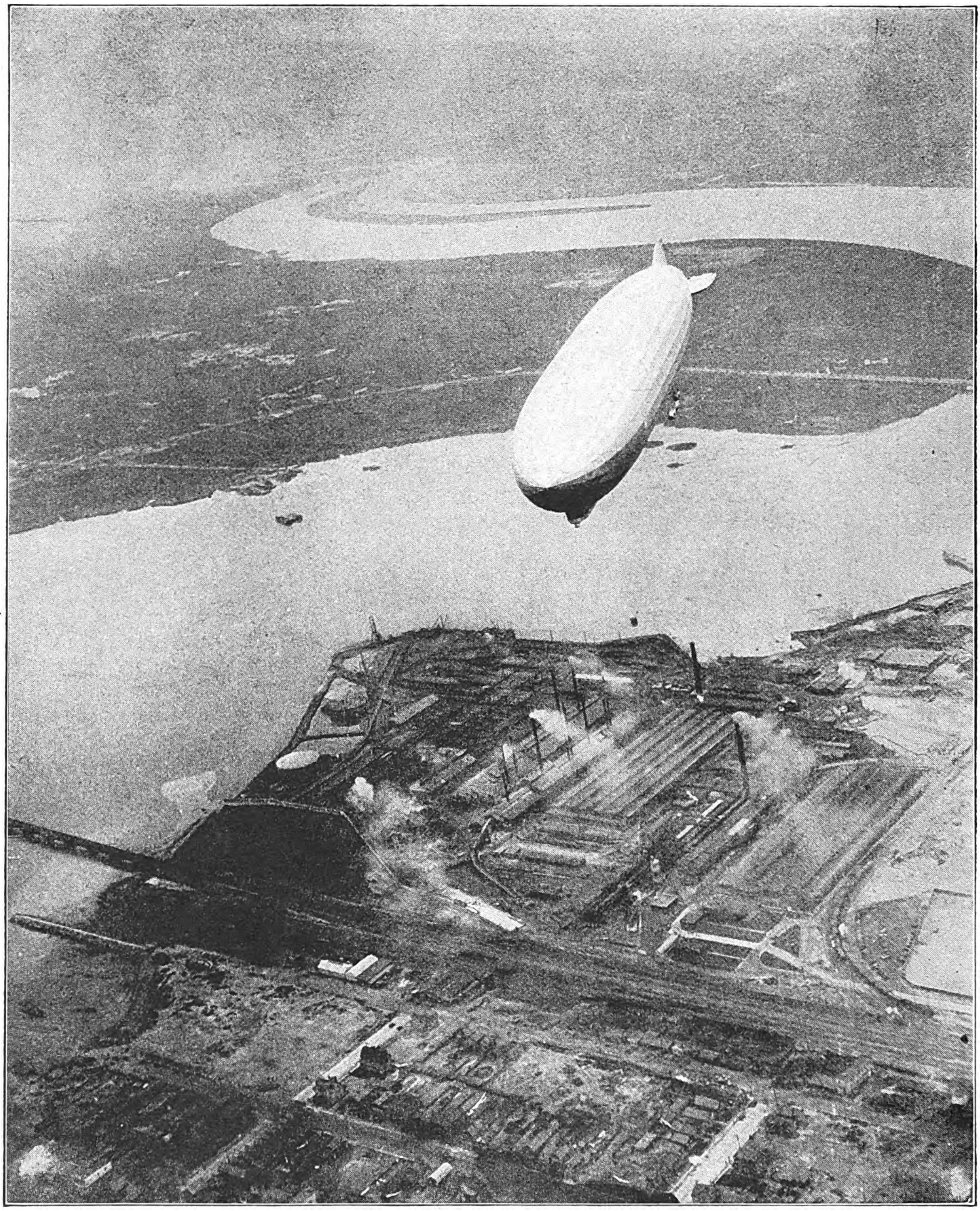
Cars That Stay Young

MAKE	**MODEL**	Front Wheels	Rear Wheels	Pinion	Steering	Differential
Auburn	All	.x.	.x.	.x.	...	.x.
Cadillac	All	.x.	.x.	...	.x.	.x.
Chandler	65 & Royal 75	.x.	.x.	.x.	...	.x.
	New Big 6 & Royal 85	.x.	...	.x.	...	.x.
Chrysler	De Soto	.x.	.x.	.x.	...	.x.
	Plymouth	.x.	.x.	.x.	...	.x.
	65 & 75	.x.	.x.	.x.	...	.x.
	80	.x.	...	...	...	.x.
Cunningham	All	.x.	.x.	.x.	...	.x.
Dodge	All	.x.	.x.	...	...	.x.
Durant	M4 and D60	.x.	.x.	.x.	...	...
	D70 & D80	.x.	.x.	.x.	...	.x.
Elcar	6-70	.x.	...	...	...	.x.
	8-78, 8-82	.x.	.x.	...	...	.x.
	8-91, 8-92	.x.	.x.	...	...	.x.
Ford	All	.x.	...	.x.	.x.	.x.
Franklin	All	.x.	.x.	.x.	.x.	.x.
Gardner	All	.x.	.x.	.x.	...	.x.
Graham-Paige	612	.x.	.x.	.x.	.x.	.x.
	615	.x.	.x.	...	...	.x.
	621, 827, 837	.x.	.x.	...	.x.	.x.
Hudson and Essex	All	.x.	.x.	.x.	...	.x.
Hupmobile	Century 6	.x.	.x.	.x.	.x.	.x.
	Century 8	.x.	.x.	.x.	.x.	.x.
Jordan	All	.x.	.x.	.x.	.x.	.x.
Kissel	All	.x.	.x.	.x.	...	.x.
Kleiber		.x.	.x.	.x.	...	.x.
LaSalle	All	...	...	...	...	.x.
Lincoln	All	.x.	.x.	.x.	.x.	.x.
Locomobile	All	.x.	.x.	...	...	.x.
Marmon	68	.x.	...	...	...	.x.
	78	...	.x.	...	...	.x.
McFarlan	All	.x.	.x.	.x.	...	.x.
Moon	All	.x.	.x.	.x.	...	.x.
Nash	Std 6	.x.	.x.	.x.	...	.x.
———	All	.x.	...	...	...	.x.
Peerless	8-69	.x.	.x.	...	...	.x.
	6-91, 6-60 and 6-80	.x.	.x.	.x.	...	.x.
Pierce-Arrow	81	.x.	.x.	.x.	...	.x.
	36	.x.	.x.	...	...	...
Reo Flying Cloud	The Master	.x.	.x.	...	.x.	.x.
	The Mate	.x.	.x.	...	...	.x.
Roamer		.x.	...	...	...	...
Stearns-Knight	All	.x.	.x.	.x.	.x.	.x.
Studebaker and Erskine	All	.x.	.x.	.x.	.x.	.x.
Stutz	All	.x.	.x.	.x.	...	.x.
Willys-Overland	Whippet 4	.x.	.x.	.x.	.x.	.x.
	Whippet 6	.x.	.x.	.x.	.x.	.x.
	56	.x.	.x.	.x.	.x.	.x.
	66-A	.x.	...	...	.x.	.x.
	70-A	.x.	...	.x.	.x.	.x.

TIMKEN *Tapered Roller* **BEARINGS**

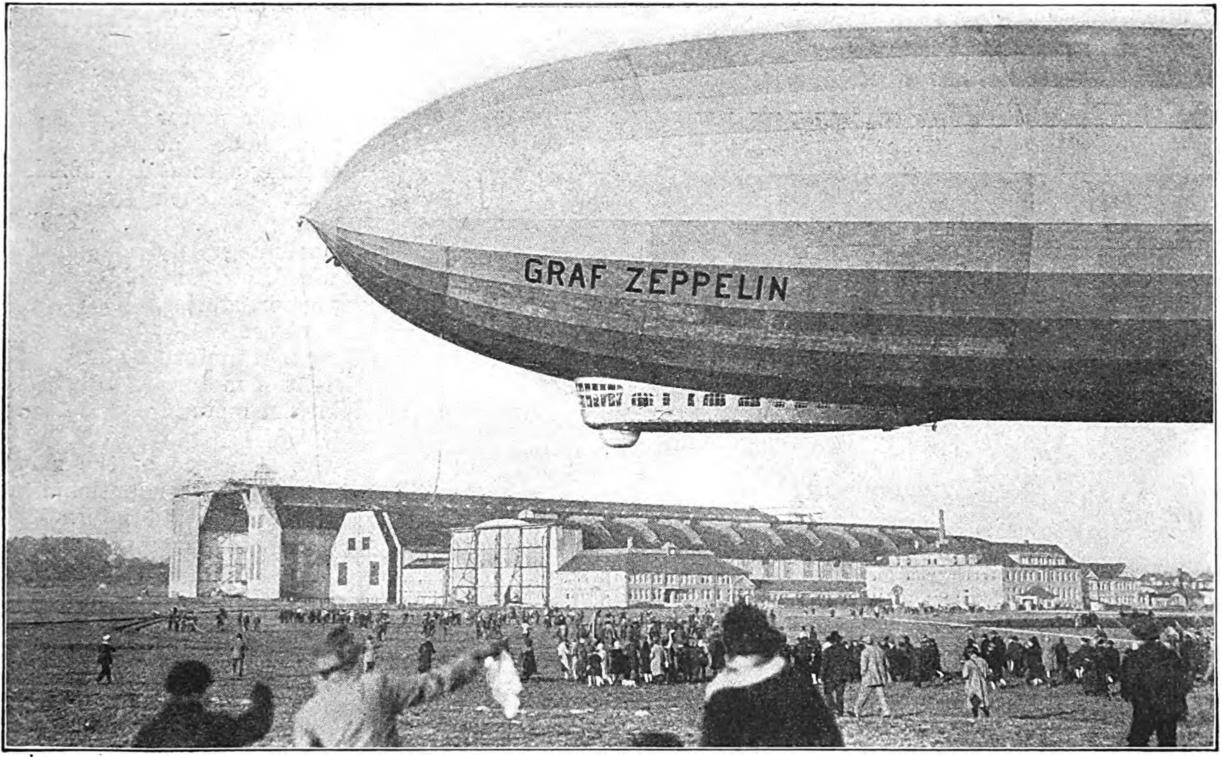
Commander Richard E. Byrd, U. S. N. (Ret.)

FEW of those who are following the news of "Dick" Byrd's antarctic expedition are aware of the extent of his polar experience. Before the war he flew in sub-arctic regions with a governmental airplane survey in icy Newfoundland. He is such an expert navigator that when he flew to the North Pole and return in 1926, the perfect plotting of his course both ways elicited the praise of experts all over the world. After his almost disastrous non-stop transatlantic flight in 1927, he immediately began preparations for his present expedition and got together the most complete outfit of its kind in the history of polar exploration. He expects to solve many secrets of the Antarctic continent in airplane flights covering a period of perhaps two years. His expedition is now at its base.



Sailing Serenely After a Stormy Trip

THE German *Graf Zeppelin,* present holder of the world's record for size, as she appeared from one of the welcoming airplanes while over Perth Amboy, New Jersey, on her way to New York City after her successful trip over the Atlantic in October, 1928. Over a hundred hours previously, she had taken off from Friedrichshafen, Germany, where she had been constructed, had headed for the United States by way of the Azores and Bermuda, had been thrown off her course by storms and wind, and had sustained severe damage to one elevator. On her arrival, she flew over Washington, Philadelphia, and New York, and then proceeded to Lakehurst where she berthed. Her return trip to Friedrichshafen required slightly over 71 hours.



NOSING DOWN TO A LANDING

The *Graf Zeppelin*, greatest dirigible in the world at this time, preparing to make a landing at Friedrichshafen, Germany, after one of its trial flights. The hangar farthest to the left is the one used during construction of the ship

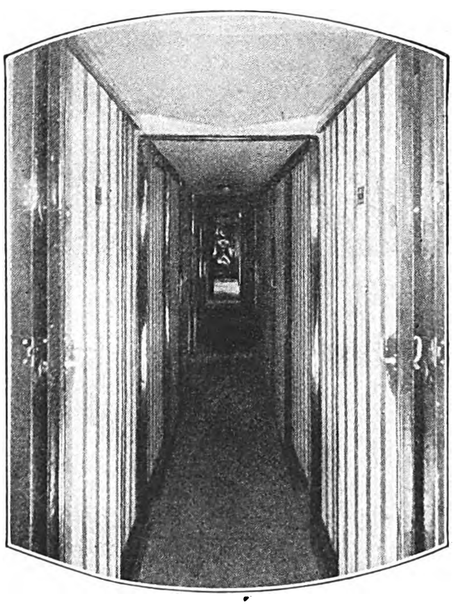
Inside the "Graf Zeppelin"

The United States' Official Observer on the Monster Dirigible's Flight to America, Tells the Details of Its Construction

BY C. E. ROSENDAHL
Lieutenant Commander, United States Navy

FOR the moment, the German rigid airship *LZ-127*, named after that most famous exponent of airships, Count Zeppelin, is the largest aircraft in the world. Although not privileged to enjoy this distinction very long because of the promised early advent of British and, a little later on, our American naval airships, the *Graf Zeppelin* is approximately half again as large as its immediate predecessor, the *Los Angeles* of 2,600,000 cubic feet gas volume, and contains certain innovations. Because of these new features as well as because of her recent historical round trip between inland Germany and the United States, the characteristics of this ship demand attention.

It is generally known that modern design tendency is toward the comparatively shorter and fatter type of airship, or toward a smaller "fineness ratio." In this respect, however, the *Graf Zeppelin* is of the previous conventional Zeppelin style rather than of the well-recognized breed of the smaller fineness ratio. Faced with the mission of constructing a ship of an advanced performance and having no choice of suitable building sheds, it became necessary to design the largest ship possible of erection in, and operation from, one shed at Friedrichshafen; therefore the characteristics of the *Graf Zeppelin* were almost automatically determined by the dimensions of this shed. The Luftschiffbau Zeppelin can therefore be said to have done very well in producing so successful a ship in spite of certain fundamental initial difficulties.

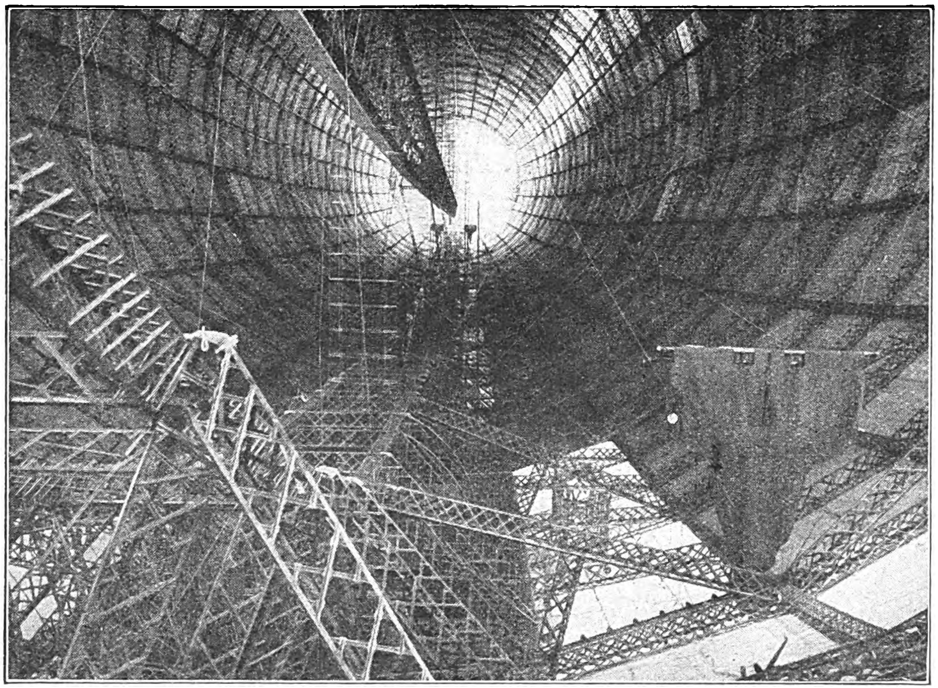


THE CENTRAL CORRIDOR

Looking aft down the corridor in the cabin space. Cabin doors on each side

A glance at the main dimensions and characteristics of this ship is desirable at this point:

Length	770.995 feet
Maximum diameter	100.06 feet
Fineness ratio	7.7 to 1
Overall length	776.408 feet
Maximum height—Axis horizontal and on forward buffer bag	110.788 feet
Maximum height—Ship on both forward and after buffer bags	113.024 feet
Nominal gas volume (95 per cent fulness)	3,708,000 cubic feet
Maximum possible volume	



All Photographs Courtesy "*Luftschiffbau Zeppelin*"

INTERIOR VIEW OF THE NEW ZEPPELIN, WITHOUT CELLS

What appears to be a jumble of girders, struts, and wires: the *Graf Zeppelin's* interior before installation of gas cells. Main frame wiring, keel passage, and upper corridor are visible

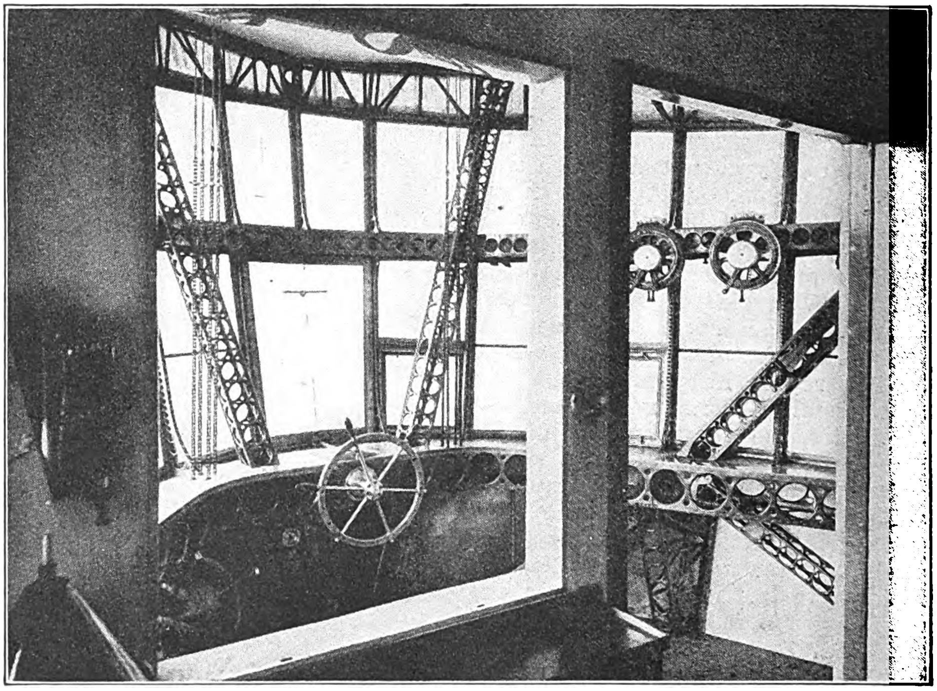
of lifting gas cells about	3,178,000 cubic feet
Normal inflation volume of lifting gas cells about	2,295,000 cubic feet
Maximum capacity of fuel gas cells about	1,482,000 cubic feet
Number of lifting gas cells	17
Number of fuel gas cells	12

The motive power consists of five wooden "pusher" propellers each driven by a V-type Maybach motor. These units are contained in five separate exterior power cars suspended from the hull of the ship in the conventional manner—that is, two pairs of wing cars and one after centerline car, or identical with the *Los Angeles'* arrangement. Power cars are so placed as to minimize air flow interference.

THE type of Maybach motor—the VL-2—used in the *Graf Zeppelin* is fundamentally the same as that in the *Los Angeles* except for certain recent refinements and advances such as an increase in the compression ratio and in the revolutions per minute which result in increased horsepower over the VL-1. The principal characteristics of this motor are:

Number of cylinders	12
Cylinder bore	5.510 inches
Stroke	7.086 inches
Cylinder volume	2025.00 cubic inches
Compression ratio	7 to 1
Rated horsepower at 1312 feet above sea level	550
Revolutions per minute at above horsepower	1600
Fuel consumption per hour per motor at 1600 revolutions per minute—about	257.940 pounds
Oil consumption per hour per motor at 1600 revolutions per minute—about	5.51 pounds
Cruising speed, revolutions per minute	1450 to 1500
Horsepower developed at cruising speed	450
Fuel consumption per motor per hour at cruising speed	202.825 pounds
Weight of each motor (including fly wheel, air compressor, starter, et cetera.)	2535.3 pounds
Length of motor	6.397 feet
Height of motor	3.18 feet
Width of motor	3.05 feet

The structure of the ship follows, of course, the conventional incorporation of main and intermediate rings or tranverse members, and main and intermediate longitudinals. Main rings are stiffened by wire bracing and are spaced 49.2 feet apart. Intermediate frames or rings occur every 16.4 feet. The cross-sectional shape is that of a 27-sided polygon. A main longitudinal corridor of triangular cross-section, running the length of the ship along the bottom, provides the usual access throughout the ship and has branching corridors leading to the wing power-cars. Necessitated by the use of a gaseous fuel, there has been incorporated another longitudinal corridor or gangway located at about two fifths of the diameter up, or where the lift-gas cells and the fuel-gas cells would normally meet, when inflated, and extending for the length of the 12 fuel-gas cells. Several vertical trunks are provided for communication and passage between the two longitudinal corridors. The usual ventilation trunks to the top of the ship



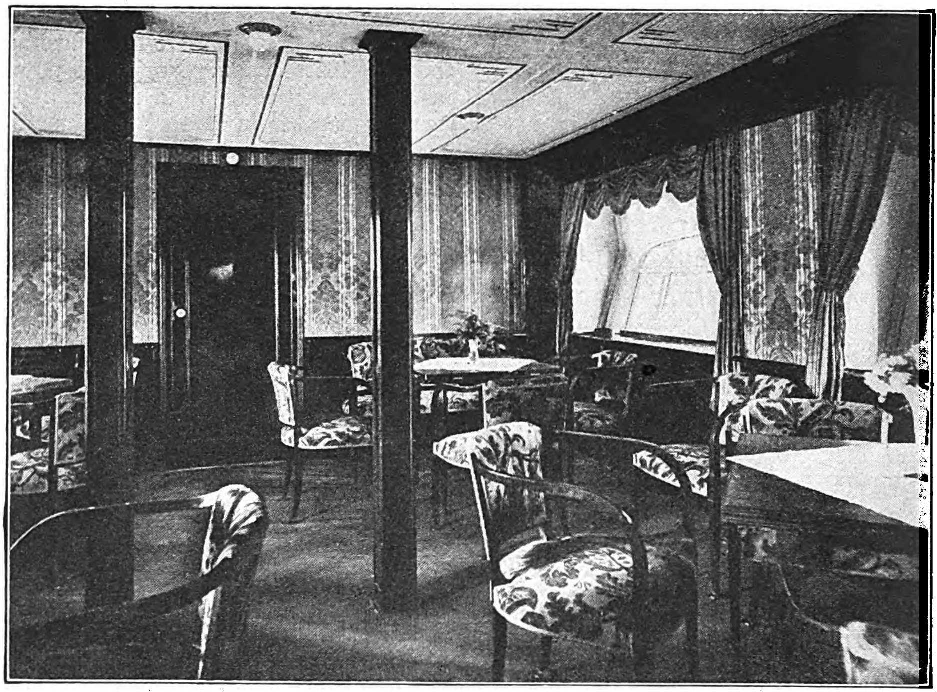
THE "BRIDGE"

View from the port side of the navigator's room into the control space. The rudderman's wheel and the engine telegraphs—on window frames at the right—are clearly shown here are installed in the conventional manner.

In general, triangular girders, either double or treble latticed, are used throughout. The duralumin employed in the structure of the *Graf Zeppelin* is an improvement over previous grades of this material and is said to be 20 percent stronger for the same weight than similar structural metal used in the *Los Angeles*.

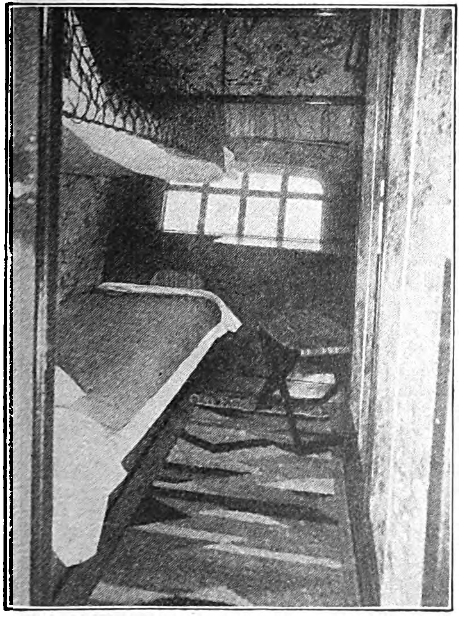
THE gas cells are located in the compartments formed by the main rings and lined with a ramie cord netting. The lifting-gas cells occupy the upper portion of these spaces whereas 12 of the lower spaces contain fuel-gas cells. Three spaces at one end and two at the other contain only lift-gas cells. In the compartments containing both types of cells, the upper or lift cells are of such size that under normal operating conditions they are never full. All lift-gas cells are equipped with automatic valves to relieve possible excess pressure; certain of them are equipped also with maneuvering valves operated from the control car. None of the fuel-gas cells have automatic valves as they are built of a size considerably greater than their normal fulness and in case of excess expansion and consequent interior pressure, the release of lifting gas through the automatic valves of the lift cells above would compensate. Some of the fuel-gas cells are equipped with hand-operated valves. The material of both lift and fuel cells is the same; it is a cotton fabric lined with two layers of goldbeater's skins and varnished and aluminized on both sides.

The stabilizing and control surfaces are four each of the usual streamlined types located at the stern. The upper vertical and the two horizontal fixed surfaces are each 1722 square feet in area. The lower vertical fin is 1302.4 square feet. The lower rudder is of 215.28 square feet, whereas the upper rudder and the two elevators (or horizontal rudders) are each of 269 square feet area.



LIKE A LUXURIOUS SHIP'S LOUNGE

The dining salon of the *Graf Zeppelin*, looking aft. The door shown leads out into the cabin space. This very attractive room is amply large to be used as a lounge for 24 persons



READY FOR SLEEPING

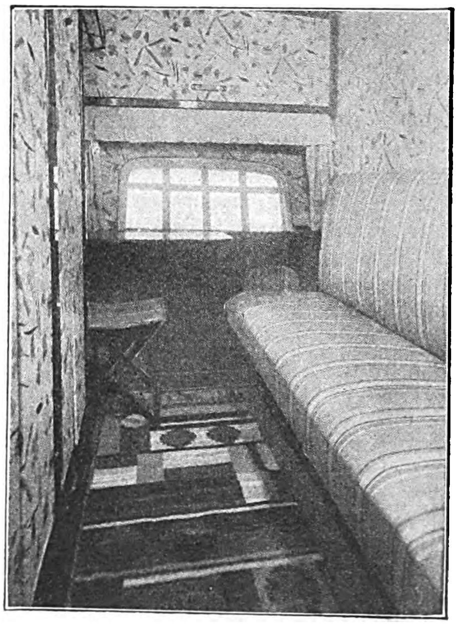
Sleeping cabin made up for the night. Ventilator control is above window

HAND power steering of the satisfactory type of the past is employed and functions easily and freely, although in larger ships the use of servo-motors may prove desirable or necessary. The rudders and elevators can be operated throughout an arc of 20 degrees on either side of neutral. The elevators are of the balanced type whereas the rudders are unbalanced.

The outer cover is an especially strong light cotton fabric stretched and laced on in longitudinal panels with the edges overlapped by sealing strips. This cover is treated with "dope" and aluminized after being laced in place. The whole surface is then sand-papered to give as smooth a finish as possible. Certain portions of the bow and stern and the control and stabilizer surfaces are covered with a slightly heavier and stronger fabric.

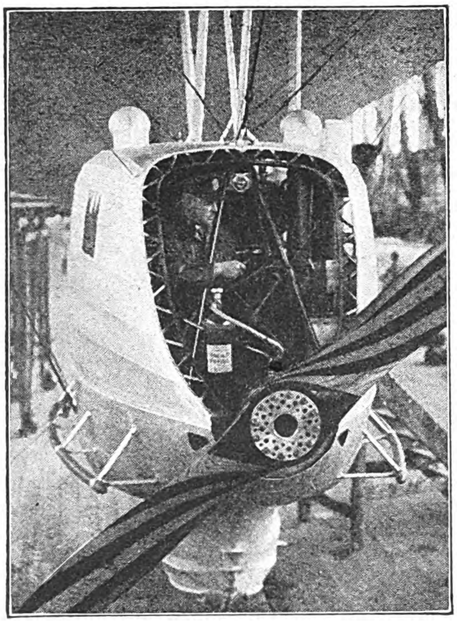
The forward car, which includes within it the control room (bridge), navigator's and radio rooms, kitchen, dining salon, cabins, and other passenger accommodations, is an integral streamlined part of the structure located well forward so as not to add cross-sectional area or height to the ship. The steering room, or bridge proper, is located in the extreme forward end of the car where the best vision is possible. Immediately adjoining it is the navigator's work room extending across the width of the car. This can be cut off by light-proof screens. Then come the kitchen to starboard and the radio room to port. Next is the spacious dining salon and the passenger cabins, washrooms, and toilets. Access from the hull into the forward car is provided by a ladder from the keel passageway into the navigator's room and by a staircase from the after end of the car into the keel.

In the control or steering room we find the rudderman's stand, the elevatorman's stand, the engine telegraphs, and miscellaneous controls and instruments. Wheels similar to those of surface ships move the steering surface aft through sprockets, chains, and control wires along the keel.



CABIN DURING THE DAY

One of the cabins made up for day use. Clothing closets are opposite the couch



THE AFTER POWER CAR

Engine car partially open to show working space. Note handling rails

The rudderman's stand is equipped with a ship's magnetic compass, rudder position indicators, and a windshield wiper for clearing vision ahead. Because of the absence of steel and other deviation inducing materials from the vicinity of the compass, no compensating binnacle is necessary. A readily operated clutch allows the rudderman to disconnect the upper or lower rudder should either be damaged; ordinarily they are operated together.

At the elevatorman's stand which is on the port side we find: two inclinometers; a statoscope; a variometer; an altimeter; thermometers for air, fuel gas, and lifting gas; a gas-pressure alarm of new and clever design; two elevator indicators and a clutch similar to the rudderman's; and a stop watch. Just above and near the elevatorman is located the control box providing the toggles for ballast and gas control.

ON the starboard side at the captain's stand are the engine telegraphs to each power car, an airspeed meter, and a variometer. In the navigator's room, in addition to the chart table and stowage for charts, books, and instruments are provided: a fluid compass, an altimeter, a barograph, an aerograph, an airspeed meter, drift and ground speed meters, a recording thermometer for air, gas, and fuel temperatures, and the usual astronomical navigational instruments and accessories common to any ship. Interior communication is provided by voice tubes to certain locations and by a telephone in the navigator's room connected to five other stations throughout the ship.

Electrical power is used for lighting purposes, cooking, heating water, radio, and telephone. The principal power sources are three wind-driven generators and a 100 ampere-hour storage battery installation. For radio power a constant-speed, wind-driven, 600-watt generator is located on the port side of the radio room. An emergency radio motor-generator, driven by the lighting batteries, is available for short emergency use. Also, a small gasoline-driven generator is located under the floor of the navigator's room. It is interesting to note that this generator was used during periods of low air-speed after the stabilizer damage on the trip to the United States. A wind-driven cooking generator is installed outboard of the kitchen on the starboard side. Another such generator of 1.5 kilowatts power is located at the after end of the passenger car for charging the battery installation, et cetera. Additional electrical equipment is a portable signal searchlight, a motor for the radio antenna reel, and a radio-battery charger. All switches are of the enclosed, safety type.

The radio equipment consists of a main transmitter of 120 watts power operating on wavelengths of 575 to 2300 meters; an auxiliary 70-watt transmitter including wavelengths from 300 to 1800 meters; and three receivers for wavelengths between 300 to 4000 meters. The suspended two wire antenna may be reeled in by power or by hand. A radio compass for use on wavelengths of 400 to 4000 meters is provided, the compass coil being located in the buffer bag of the forward car. Short-wave radio equipment is contemplated and provided for. Three radio operators are carried and a continuous watch is stood.

THE passengers' dining salon, 16.4 feet square, affords much comfort also as a lounging room for 20 to 24 persons. Tables, chairs, and settees are provided in abundance and the large windows on each side—some sliding open—provide a splendid protected view during flight. The walls and ceilings of the salon and the cabins are covered with fancy cloth, each cabin finished in a different design. All passenger spaces are ventilated. At the present they are not heated but such an installation can be provided readily.

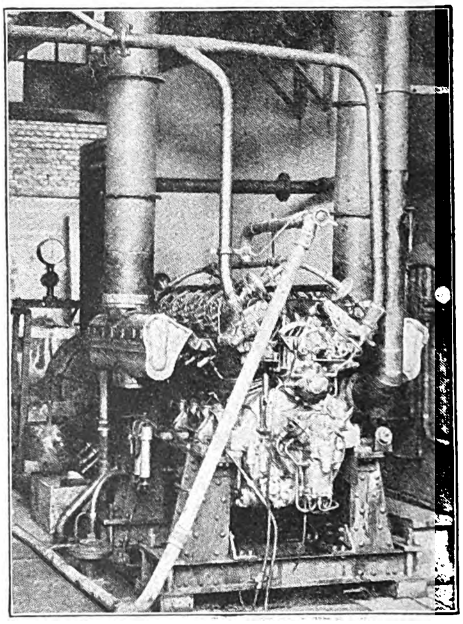
The sleeping cabins are located on each side of a central corridor abaft the dining room. There are 10 separate two-berth cabins each equipped with clothes closets, a table, a collapsible chair, an outboard window, and electric lights. Abaft these in a compartment cut off by doors are found two washrooms, toilets, and a storeroom. Each washroom contains two washbowls, mirrors, et cetera; hot and cold water is supplied from the faucets. Special racks for baggage other than hand luggage and for freight are located in 34 spaces along the keel passageway. Noise from the engines, which are well aft, does not disturb the passengers at all.

The quarters for the ship's officers and crew are located up within the hull proper along the keel passageway. The captain has his own stateroom; three other staterooms equipped with tables and seats are provided. Sleeping berths for the crew, shielded from the draft, are located along the keel. Excellent ventilation is had to rid the ship of any gas which might leak through the cells. Automatic ventilating hatches and an exhausting hood are installed for this purpose.

BENZINE, the secondary fuel used in the *Graf Zeppelin*, is carried in seven groups of three aluminum tanks each. These hold 110 gallons each.

Enough benzine is carried ordinarily to offset the lift of the largest gas cell in case of deflation, as the fuel tanks are so suspended that they may be readily dropped from the ship. Provision for additional fuel tanks is made at a number of locations. All tanks are connected to a common fuel main. Wind-driven pumps are available for transferring fuel for trimming purposes and for sending fuel to the service tanks near each power car from which the engines are fed by gravity. Lubricating-oil tanks are provided at convenient locations in the keel. The motors are started and reversed by compressed air, each having its own compressor and air bottles. The air line from each cuts into a common air line so that any engine may furnish air to any other.

Fuel gas cells are connected by an aluminum pipe line equipped with specially designed valves. Smaller branch lines run to the power cars. The suction of the motors draws the



TESTING AN ENGINE

One of the dirigible's Maybach engines being tested before its installation fuel gas from the cells and engines may be fed from any cell or combination.

Some of the *Graf Zeppelin's* improvements over past airships have already been indicated, but the principal advance is represented in the adoption of a gaseous fuel.

One reason for the adoption of a fuel of this type is that a greater number of heat units can be carried and an increase in cruising radius of 20 to 25 percent becomes possible over that which can be obtained with a hydrogen-gasoline ship.

Secondly, there is a reduction in the stresses in the structure of the airship due to the absence of heavy fuel loads. It is easy to visualize the stresses that can be set up in the structure by a heavy fuel load when the ship is subjected to the currents and instability of squalls or storms. The main advantage, however, lies in the non-disturbance of the static relation between load and lift due to the consumption of a fuel of the same density as air.

WHILE the introduction of gaseous fuel as an operating feasibility is a novel departure from past practice, it is not an entirely new idea. It has often been proposed that hydrogen inflated airships might increase their range by burning excess lifting gas as fuel but this was practicable only to a small extent. The use of coal gas as an inflation medium and as a fuel as well was also suggested years ago but the use of Blaugas was first put into practice in the *Graf Zeppelin.*

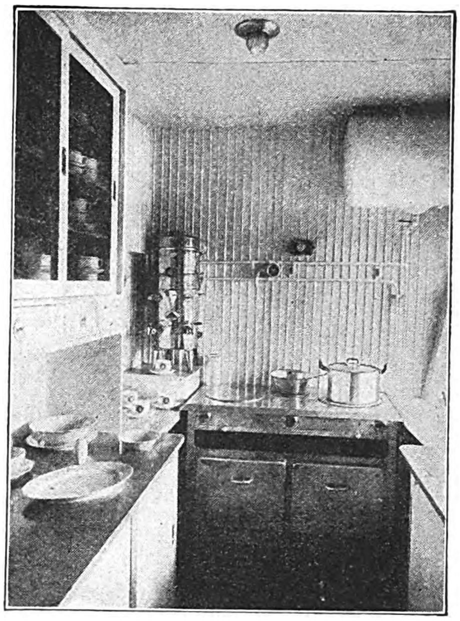
As may be generally known, when an airship (or any balloon) takes off, ballast is adjusted to make the lift or buoyancy predominate slightly over the load so that the craft rises statically into the air. As the loads within the ship are consumed—which in the ordinary ship are principally the fuel—the lift would, unless compensated for, soon predominate to a point where a considerable portion of the dynamic power of the ship would have to be used to overcome the excess buoyancy and maintain the flight at the desired altitude. Of course, it is possible to reduce this excess buoyancy by valving or releasing a portion of the lifting medium. In the case of a hydrogen-inflated ship, while costing something appreciable, it is nevertheless practicable. In a ship inflated with helium, such operation might prove more expensive. In our American helium-inflated airships, however, the expenditure of fuel is compensated for by the condensation and collection of the water of combustion from the engines and the occasions on which valving must be resorted to are very rare. The adoption of Blaugas, however, solves, in a different manner, the matter of maintaining the static equilibrium of the ship.

BLAUGAS, named after the German chemist, Doctor Blau, who first invented the manufacturing process, is a hydrocarbon gas produced from crude oil. Its density is approximately that of air—actually about 1.05. It is stored in the ship as previously indicated in fabric gas-cells and is, therefore, always at atmospheric pressure. As Blaugas is consumed—since it is of the same density as air, or approximately so—there is no reduction in the load of the ship because of the consumption of fuel. The shift from gaseous fuel to benzine, or vice versa, is easily accomplished, as the Maybach engines are equipped with a simple mixing valve which permits this change readily.

One of the difficulties in the employment of a gaseous fuel is that of obtaining and transporting it. Difficulty is still being experienced in Germany with the production of Blaugas from crude oil on a quantity basis. In the United States we are more fortunate, however, in that our natural gas sources in many localities provide gases suitable for mixing to form a fuel of the required density, calorific value, and other properties. The greatest item of expense and trouble lies in the fact that this gas must be compressed into liquid form and shipped under pressure. It is readily apparent therefore that there are difficulties and expense involved in placing a gaseous fuel at the points where a few airships might require it. Furthermore, in the United States, we have a great abundance of helium for use as the inflation medium of airships and it is still a point for argument whether anything in safety to our ships would be gained by the introduction of a gaseous fuel. The maximum safety from this standpoint will be achieved when airships combine the use of helium as the inflation medium and heavy-oil engines as their propulsion plants.

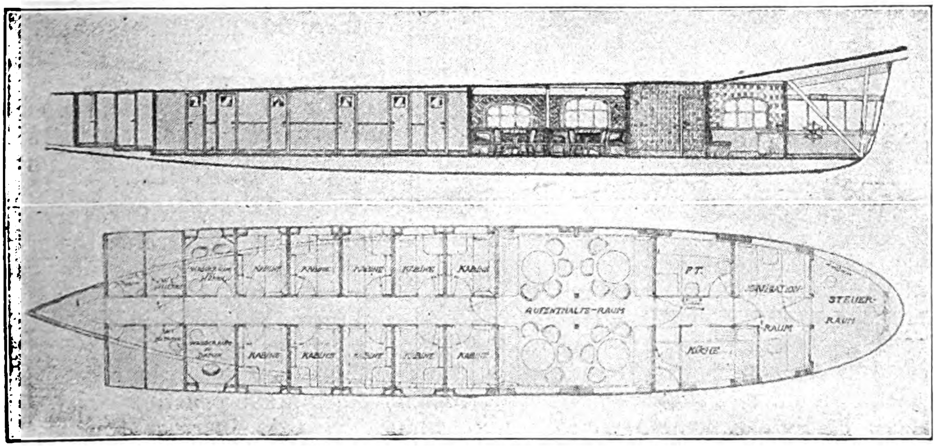
THE maximum speed of the *Graf Zeppelin* is slightly less than 80 miles per hour, but it is expected that this will be brought up to 80 or over. The cruising speed of the ship is 70 miles per hour. After her historical first crossing of the Atlantic covering a distance of 6000 miles—the time having been drawn out to 112 hours because of a damaged stabilizer enroute—there still remained a 65 hours' fuel supply.

While the *Graf Zeppelin* is probably the strongest airship yet built, the regular commercial conquest of the North Atlantic will undoubtedly be made by even stronger and larger ships. While this region is, no doubt, one of the most lucrative in the realm of transportation, it is, nevertheless, one of the most difficult for the operation of any type of carrier, as steamship operators realize each winter. There are many fields of fruitful endeavor open to the *Graf Zeppelin* and without a doubt this ship will prove an important milestone in the development of the ultimate universally useful rigid airship.



THE GALLEY

The kitchen of the new dirigible is electrical. Note orderly arrangement



CONTROL AND PASSENGER CAR

From bow to stern, the rooms are as follows: The steering room; navigation room; kitchen; dining room; 10 passenger cabins; washrooms—one for men and one for women; and toilets

AN UP-TO-DATE AIRPORT

A vital part of flying is the provision of suitable landing fields and adequate servicing facilities. Fields of this type give great impetus to private flying by providing safe and convenient centers for flying activities

Courtesy Curtiss Aeroplane and Motor Company

Planes for Private Flying

A Comprehensive Survey of the Aviation Field, as it Concerns the Individual Who Desires to Purchase a Plane for Personal Use

By Prof. ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University
Corresponding Editor, SCIENTIFIC AMERICAN

MILLIONS of people in the United States are deeply interested in flying and hundreds of thousands have already taken short or long flights. To have flown once generally means to wish to fly again. The air seems to offer a refuge from crowds, from roads congested with automobiles, and to give the ultimate in freedom of motion. To many young men, the ownership of a plane is a fascinating thought. The sky will not be darkened with "flivver" planes for many years to come, but private owners will increase rapidly in numbers. Therefore, it will not be amiss to discuss some of the aspects of private flying.

PRIVATE flying is a sport which needs careful preliminary training. Care is always needed and overconfidence is dangerous. But flight surgeons, flying instructors, and other competent authorities are all agreed that almost anyone can learn to fly who so desires, provided he is young, and has a good physique, quick reflexes, and fair presence of mind.

Skill in driving an automobile, ability to sail a boat, good "hands" on a horse, and skill in rapid games are all good auguries of flying ability. There are many excellent flying schools available, in which one can learn to fly "solo" in 10 hours, and secure the Private Pilot's license of the Department of Commerce. Ways and means can be found of securing the greater experience which is necessary for independent cross-country flying, even in good weather.

Let us now concentrate attention on the first essential of private flying—a good plane. In purchasing an airplane we must look first of all to its flying characteristics. A maximum speed of at least 100 miles per hour is necessary.

> **THE question of what airplane to buy is one which is of great moment to an increasingly large number of laymen. The available information is meager and is scattered to such an extent that the average non-technical but airminded person is at a loss as to where to obtain accurate data. True, biased opinions are readily found, but in a matter such as this, biased opinions are to be avoided. For this purpose, the accompanying article was prepared. It will be found invaluable to the aeronautical tyro.—*The Editor.***

Speed is, after all, the main justification of the airplane. It is uneconomical of fuel to fly with engines "all out"—cruising speed is always 10 to 15 percent less than maximum speed, and head winds have to be allowed for.

The landing speed should not be more than 40 miles per hour. A highly skilled pilot can land a racing plane on a specially prepared flying field at 100 miles per hour without damage, but a private owner who wishes to make cross-country flights may have to land in a small emergency field. Low speed lessens the shock of a poor landing, and also reduces the chance of nosing over. Furthermore, a slow landing means that there is less energy of motion to be taken up, and therefore a shorter landing run becomes possible. Planes that land slowly, unless very much under-powered, are also capable of making a get-away after only a short run. This is very helpful where a minor defect has brought the pilot down in a small field.

THE Daniel Guggenheim Safe Aircraft Competition has been established, with a major prize of 100,000 dollars and five minor prizes of 10,000 dollars each, for the express purpose of encouraging progress at the lower end of the performance scale, without undue sacrifice of good high-speed and load-carrying characteristics.

The easiest way to secure low landing speed is to increase the wing area. But a large wing area for a given gross weight means bumpy flying in gusty weather and also entails loss of maximum speed.

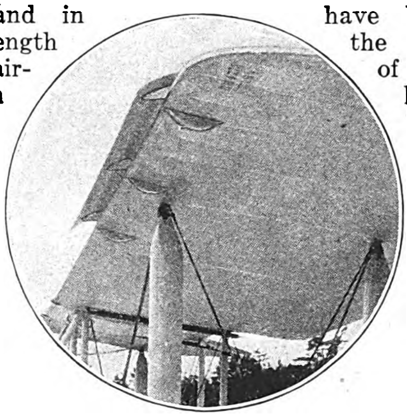
The next step in airplane design is therefore to make practical the use of some device to increase the lift capacity of the wing on landing.

Such devices involve increasing the wing area by sliding out a portion of the wing, turning down the rear portion of the wing in the form of a flap; varying the camber or thickness of the wing, or using the Handley Page slot. All such devices involve some degree of complication and increase in weight; nevertheless they deserve the most careful attention and one or another of these devices will ultimately come into general use.

Very rapid climb is more valuable for a military airplane than for a commercial plane. What the commercial plane needs is the ability to climb at a steep angle so that obstacles such as trees or telegraph poles surrounding a field can be readily cleared. To observers on the ground, the climb of a modern airplane, particularly when climbing into a head wind, may appear very steep indeed. As a matter of fact, the angle of climb seldom exceeds 15 degrees to the horizontal. For steep climb the loadings of the plane in pounds per square foot and in pounds per horsepower should be low; these loadings are perhaps the first characteristics to be determined when purchasing a plane.

STABILITY in normal flying is another requirement of the Safe Aircraft Competition. A plane should be able to fly "hands off" for several minutes even in gusty air, and there is no doubt that a number of designs already have such stability. If a prospective purchaser is taken up for a trial ride, he may (at a safe altitude) ask for a number of simple tests to demonstrate stability. For example, suppose the stabilizer is adjusted so that the plane flies "hands off" at a certain speed. If the control stick is pushed forward, and then released, the plane should soon return to its original flying attitude and speed. An unstable plane would tend to dive without recovering.

Structural failures in the air are inexcusable. The art of stress analysis is now so well understood, that a plane which satisfies the airworthiness requirements of the Department of Commerce, and whose maintenance is adequate, should never have a structural failure. In military and naval aviation, pilots must, on occasion, impose severe loads on their machines in such maneuvers as pulling out rapidly from a dive, or in the barrel roll in which the wings are rapidly rotated about the longitudinal axis of the airplane. These maneuvers are not needed in commercial flying, and in normal flying the strength of the frail looking airplane is more than adequate.



Courtesy Moth Aircraft Corporation

THE SLOT

The Handley Page slot is a feature especially popular with private owners

Accidents due to the aerodynamic characteristics of an airplane are unfortunately not so infrequent as those due to structural failure. Perhaps the most frequent source of trouble is the spinning nose dive following a stall. In this, the lift of a wing increases steadily with its inclination, until a certain maximum is reached. This occurs at an inclination of some 14 to 16 degrees. The air flow then ceases to be streamline, and tears away from the upper surface of the wing. It is said to "burble." If the inclination of the wing increases still further, the lift actually diminishes.

If in flying, the angle of maximum lift is passed, the machine is said to be "stalled." It will drop and start to dive more or less violently. The ailerons become far less operative than in normal flying, and if one wing "falls off," (falls lower than the other), the machine may refuse to come to an even keel, and instead go off into a spinning nose dive.

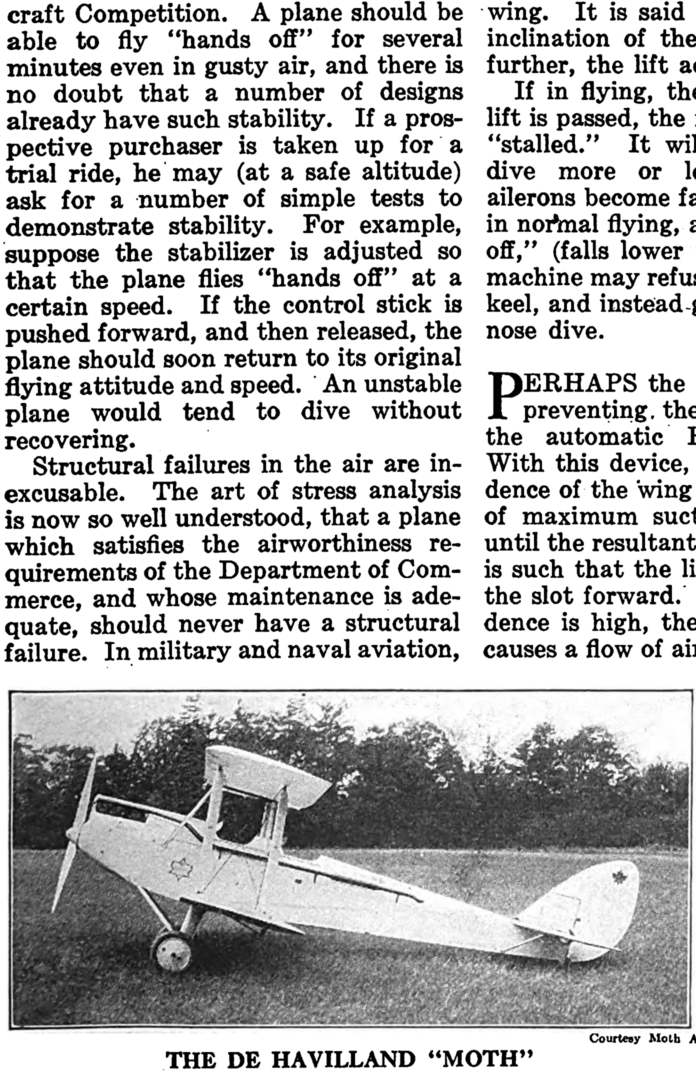
PERHAPS the very best method of preventing the stall is the use of the automatic Handley Page slot. With this device, as the angle of incidence of the wing increases, the region of maximum suction moves forward, until the resultant pressure on the nose is such that the linkage system moves the slot forward. If the angle of incidence is high, the opening of the slot causes a flow of air from the under surface to the upper surface of the wing, and the extra energy supplied to the upper surface prevents "burbling" or stalling. The automatic slot is therefore the very best safeguard so far devised against stalling.

A number of English planes have been equipped with the automatic slot. One of these, the De Havilland *Moth*, has been imported into the United States. The automatic slot has been applied only to a portion of the upper wing, but the *Moth* can be flown with ease, at very low speeds, and at an angle of incidence which would be impossible were no slots used. With the use of the slot it should be possible to glide down fairly steeply, with the nose of the machine well above the horizon. This facilitates landing in a small field surrounded by obstacles.

It is to be hoped that American designers will give increasing attention to the possibilities of the slot.

THE tendency in automobiling is towards the closed car, and for very good reasons. In the fairly large five or six seater monoplane of today, equipped with a 200 horsepower Wright Whirlwind, with an expert pilot at the controls, the enclosed cabin is almost universal. But for the small two or three seater privately owned machine, many airplane constructors remain faithful to the open cockpit.

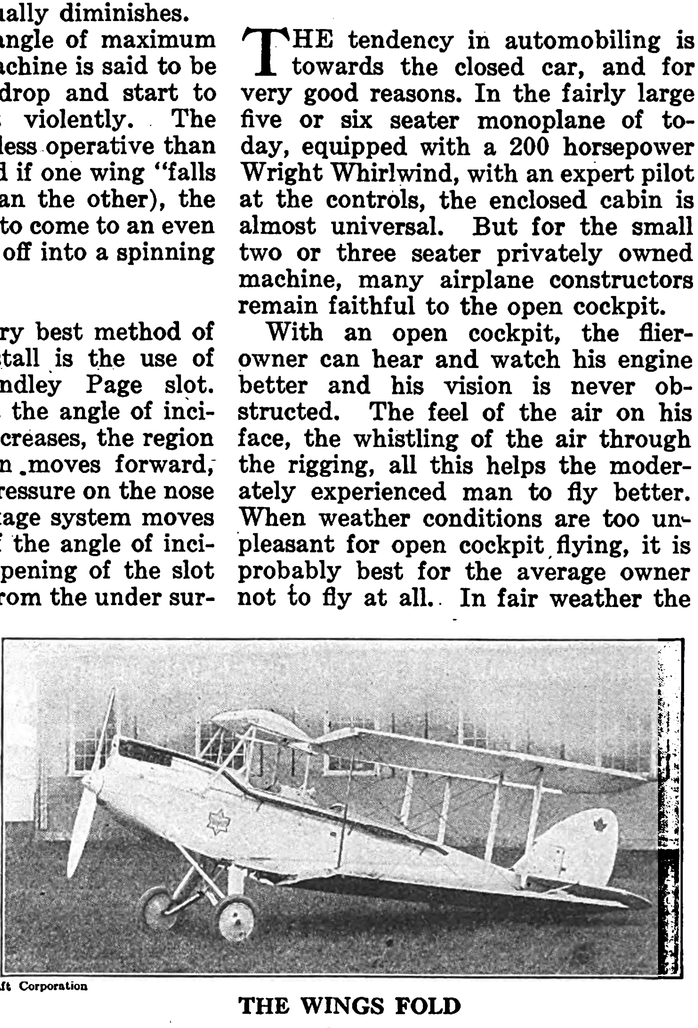
With an open cockpit, the flier-owner can hear and watch his engine better and his vision is never obstructed. The feel of the air on his face, the whistling of the air through the rigging, all this helps the moderately experienced man to fly better. When weather conditions are too unpleasant for open cockpit flying, it is probably best for the average owner not to fly at all. In fair weather the



Courtesy Moth Aircraft Corporation

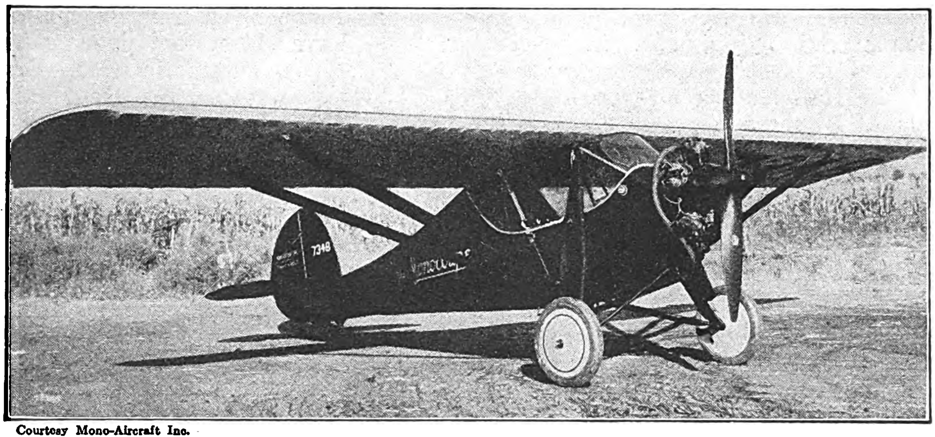
THE DE HAVILLAND "MOTH"

A small two-passenger plane, equipped with Handley Page slots. It is one of the foreign planes becoming popular in America



THE WINGS FOLD

The folding wings are especially desirable where limited hangar space is available and for towing through congested streets open cockpit gives more thrill, more pleasure, and a better view of the earth's carpet.



Courtesy Mono-Aircraft Inc.

THE "MONOCOUPE"

A two place, enclosed semi-cantilever monoplane equipped with a Velie 45 horsepower motor. An American plane which appeals to the private owner, and is reasonably priced

At one time, after the first low-power plane races in Dayton in 1923, it was thought that the "flivver" plane would become extremely popular, and that planes of 20 horsepower or so, selling at very low prices, would sweep the country. This expectation has not been realized. Very small planes of low wing loadings respond too readily to gusts. The controls need little force to actuate them, yet such ships are really very difficult to fly. Particularly in cross-country work have the "flivver" planes had a checkered career in the United States. They offer the advantages of extreme maneuverability, and the ability to land and make a get-away in very small fields. They are cheap in original price, and their gasoline and oil charges are absurdly low.

INSTEAD of the "flivver" of 20 horsepower we shall probably see a large number of 40 to 50 horsepower machines in use. Some very neat planes of this type have been built and flown successfully in recent years.

The Driggs *Dart II* is an excellent example: This neat little biplane has a total wing area of only 140 square feet, and is equipped with a 40 horsepower, three cylinder Auzam engine, yet it can carry two occupants comfortably and has a high speed of nearly 90 miles per hour.

In the small two seater class of between 40 and 50 horsepower there are exponents of the enclosed cabin. Thus the *Monocoupe* has a small neat cabin with side by side seating, although its five cylinder motor is said to develop only about 50 horsepower. The *Monocoupe* has a very distinctive appearance, and 2675 dollars at the factory is certainly an attractive price.

It will be seen from the photograph that the exhaust gases are collected into a ring, and then led into a long pipe underneath the cabin, with its opening well behind the cabin, a protection against noise and exhaust fumes. The gasoline is placed in two tanks in the wings on either side of the fuselage, giving pure gravity feed. Such a position is probably also the best from a fire prevention point of view.

The *Monocoupe* has many other attractive features and should have a large sale to private owners.

The day of the cheap plane with OX-5 engine is past, until another cheap engine finds its way on the market. But these planes have served their purpose in popularizing flying more than any other type of plane.

ONE of the best known machines in the OX-5 class is the *Waco Nine*. Entirely conventional in design, it has, nevertheless, an excellent specification. The useful load is 800 pounds, the maximum speed about 92 miles per hour, and the cruising radius 400 miles.

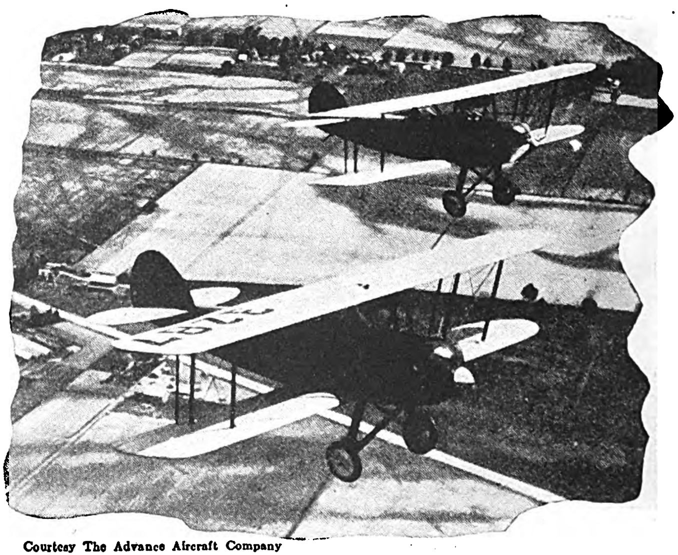
The many air-cooled engines of about the same power as the OX-5 have not yet given the long service of the OX-5 or the Wright Whirlwind, but several very promising engines are on the market. We may expect soon to see in the air a large number of planes costing around 5000 dollars, two or three seaters, and equipped with one or another of these air-cooled engines.

A typical plane of this class is the Taylor Brothers Aircraft Company's new *Chummy*. Powered with a 100 horsepower Kinner, the Taylor *Chummy* weighs 950 pounds empty and has a useful load capacity of 550 pounds, giving a gross weight of 1500 pounds. With this load and a wing area of 175 square feet, it is said to have a top speed of 110 miles per hour and a landing speed of 38 miles per hour. The fuel capacity is 30 gallons and the range at cruising speed, 500 miles.

The private owner may find as time goes on that he wants a little more speed, and more reserve power, particularly when getting out of small fields. The detachable engine mounts of the *Chummy* may then prove useful. Provided weight variations do not appreciably influence the balance, and provided the plane is originally designed to be strong enough to take a more powerful engine, there is a decided advantage in being able to replace a 90 or 100 horsepower engine with one of 125 horsepower.

LIKE golf or any other sport, flying leads to endless discussion. On almost every point in the design of a plane, there are two or more divergent opinions. Whether two-seaters should have side-by-side or tandem seating is a typical subject of discussion. Side by side is more pleasant and sociable. With dual control, communication and instruction between teacher and pupil become easy matters. On the other hand, a side-by-side fuselage must be wider and therefore offer more head resistance. With side-by-side seating, vision in landing can never be quite as good on both sides as in a tandem plane. In the *Chummy*, the side-by-side arrangement has been selected. The width of the cockpit is 38 inches, which is probably quite comfortable.

No private owner should buy a two seater without dual control. Even if he never becomes a pilot, he will find much pleasure in taking the controls occasionally. There is only one danger, and that is that an excited passenger or even a student of some few hours training may try to take control in a tight corner, and "freeze" on to the



Courtesy The Advance Aircraft Company

LATEST IN DELIVERY METHODS

A group of Wacos are being flown away from the factory—a method of delivery popular with airplane manufacturers controls, causing a serious accident, or at least a few exciting moments.

In the *Chummy,* two sticks and two sets of rudder pedals are used and the right stick is removable. There is a partition between the two sets of rudder pedals, and the student's rudder pedals are mounted on springs. In normal flying these pedals control the plane, but they can be overpowered by the pilot at any time. All the control leads are below the floor. Particularly with the student's stick removed, the pilot need not worry that the passenger will lock the controls.

We have seen that open cockpit versus closed cockpit is another source of controversy. In the *Chummy* an intermediate solution has been obtained. Behind the engine compartment is a high windshield of Pyralin closing the gap between the fuselage and the wing. The windshield is curved so as to reduce the resistance and to protect the cockpit from air spilling over the sides. The occupants are protected in the coldest weather, yet at the same time have ample vision under adverse conditions, and plenty of fresh air, the best preventative of airsickness.

At high incidence, the ailerons are never quite as powerfully operative as at high speed or low incidence. Also, the drag on the side on which the aileron is pulled down becomes very much greater than the drag on the side on which the aileron is pulled up. Therefore, when the ailerons are used to control a roll, the plane tends to swing badly off its course. A partial remedy lies in the differential controls of the ailerons. In the *Chummy,* the upward moving aileron has a displacement of 30 degrees, while the downward moving aileron has one of only 25 degrees.

Another example of the planes of this class is the Avro *Avian,* which has recently been imported and sold in the United States with real success. It is very interesting to study this example of the best English practice in aircraft manufacture.

The *Avian* is a biplane with folding wings. English designers are quite satisfied that the biplane is just as desirable as a monoplane, and they get results which compare very favorably with our monoplanes.

Courtesy Driggs Aircraft Corporation

"DART II"

A small two-passenger biplane convenient for the owner of moderate means. Its sturdy construction suggests easy maintenance. It is powered by a 40 horsepower Auzam engine

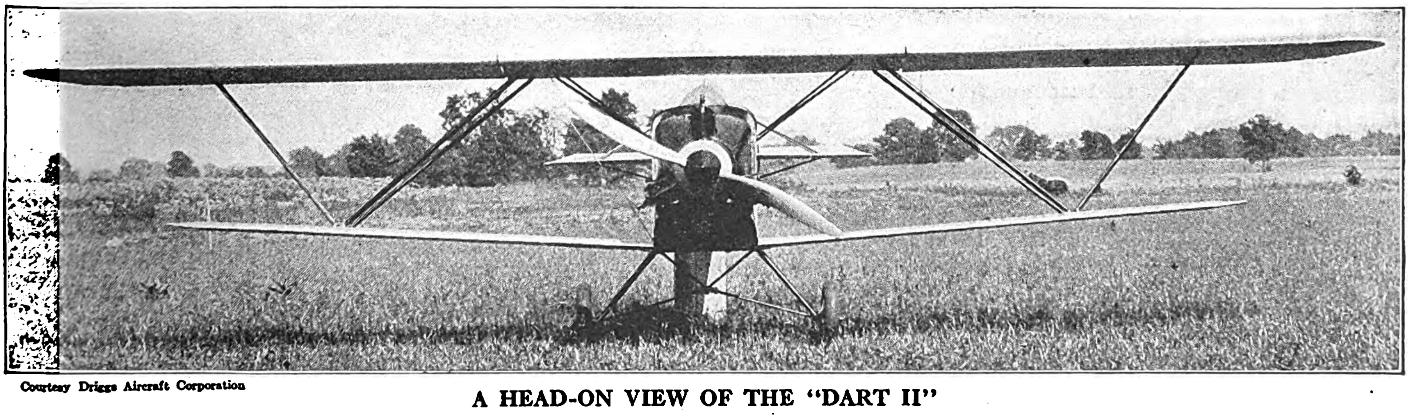
In the United States, air-cooled engines are practically all of the star or radial type. In the *Avian,* the Cirrus II, a four-cylinder air-cooled engine with all cylinders in line is employed. It is quite certain that the in-line engine will be more generally employed in the future. It allows a very neat streamline for the nose of the fuselage, and the vision of the pilot is less obstructed than in the case of the radial engine. The in-line engine also requires somewhat less mechanical skill for its maintenance.

In the wing structure, the English designers prefer to use a thinner wing than is customary in the American type of semi-cantilever monoplane. This is possible because the biplane lends itself somewhat better to bracing. For the same gross weight, the British designer prefers to use a considerably larger area which is necessary with the thin, low-lift wing.

In these small planes, which respond so readily to the controls, and have so much maneuverability, there is always a temptation to stunt. The *Avian* is designed for a load factor of 8, with which factor the Air Ministry permits acrobatics. A higher load factor than required by the minimum Department of Commerce requirement is always a good point. In instruction, particularly rough usage must be expected at all times.

The landing gear of the *Avian* offers real interest. In the wing structure, two short wing roots are attached permanently to the fuselage. These roots are triangular in plain view, with the base of the triangle formed by the leading edge and the apex at the rear spar hinge. To brace the root against the under-carriage loads, a short diagonal strut runs to the top longeron. When the wings are folded they swing, of course, around the hinge. The point of attachment of the rear chassis strut being situated some little distance out from the hinge, when the wings are folded the upper end of the rear strut moves back with the wing, and in so doing pulls the wheel back with it, and at the same time the wheel moves upward slightly. The combined effect is to lower the machine and to relieve the load on the tail skid. Thus, with the wings folded, the machine can be wheeled along quite easily by one man. Lowering the fuselage also facilitates work round the engine.

The English, as we shall see later in this article, use their light planes for flying tours. It is not surprising to learn that in the *Avian,* a luggage compartment behind the pilot's seat can accomodate two full-size suit cases, with room for tool-kit, spare tire, inner tube, et cetera. Even

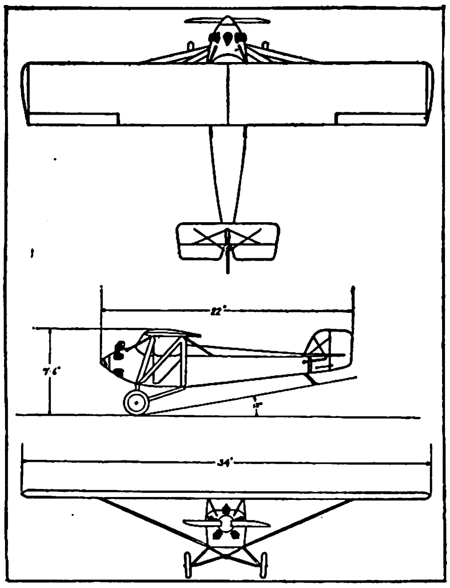


Courtesy Driggs Aircraft Corporation

A HEAD-ON VIEW OF THE "DART II"

This small plane, powered with a three cylinder radial engine, is said to attain 85 miles an hour maximum speed an emergency propeller can be carried.

As in the *Chummy*, provision against passenger interference is made. The control column in the front cockpit can be removed and the rudder bar quickly disconnected.



Courtesy *Aviation*

TAYLOR "CHUMMY"

A three view sketch showing the general characteristics of this two-place plane

The following characteristics show that the British practice, as regards performance, is neither better nor worse than American practices:

Weight empty	875 pounds
Pilot	160 "
Passenger	160 "
Gasoline	150 "
Oil	15 "
Gross Weight	1360 pounds

Maximum speed—102 miles per hour
Stalling speed—40 miles per hour
Length of run to take-off—225 feet
Length of run after landing—270 to 300 feet
Climb at ground level—650 feet a minute
Range—5 hours, or 430 miles

For the sportsman owner who intends to fly his own ship, there is much to be said in favor of the two or three seater with open cockpit. But for the man who intends to employ a pilot and to make long trips, the somewhat more powerful cabin monoplane is preferable. It is likely to cost about 12,000 dollars.

A number of splendid and luxurious closed cabin monoplanes are now available such as the Fairchild *FC-2*, the *Stinson-Detroiter*, the Fokker *Universal*, the *Ryan Brougham*, the *Travel Air 5000*, the Buhl *Air Sedan*, the *Bellanca*, et cetera.

These machines so far have been designed to carry a pilot and four passengers, although several firms are preparing planes with dual control cockpits, and compartments for four passengers.

Fashions in wing structure change quite frequently. Biplanes, cantilever monoplanes, and semi-cantilever monoplanes each have their good points.

A biplane structure suitably braced with struts and wires is the lightest and most compact, but it is not aerodynamically so efficient as a tapered cantilever monoplane in which all struts and wires have disappeared.

The semi-cantilever monoplane, with just two struts going from either side of the fuselage to the wings is a compromise. American designers seem to be in agreement, at the moment, on the all-around advantages offered.

The *Travel Air 5000* is quite typical of the semi-cantilever cabin monoplane. A circular prepared by the Travel Air Company for the N. A. C. A. gives an excellent outline of this plane, with its main dimensions.

The power plant is a Wright Whirlwind J-5-C, developing 230 horsepower at 1900 revolutions per minute. The fuel consumption at a cruising speed of 108 miles per hour is 12 gallons per hour, or nine miles to the gallon, which does not compare unfavorably with the figures for a powerful automobile.

It has a carrying capacity of one pilot, four passengers, and 50 pounds of baggage, or a pilot and 750 pounds of mail, express, et cetera.

The top speed is 123 miles per hour, and the initial rate of climb is 750 feet a minute. The landing speed is rather high—55 miles per hour. The normal cruising range is about 700 miles.

Fully loaded, the *Travel Air* weighs 3600 pounds, empty—2160 pounds. It is remarkable what a large amount of useful load (pilot, passengers, fuel, and oil) a modern plane will carry, in this case, 1440 pounds or 40 percent of the gross weight of the entire outfit.

The main dimensions of the *Travel Air* are: Span—51 feet, 7 inches; height—8 feet, 9 inches; overall length—30 feet, 5 inches; wing chord—6 feet, 9 inches; wing area—312 square feet. The load per square foot of wing area is high—11.5 pounds. So is the loading per horsepower, which is 15.65 pounds. It is only "cleanness" of design which enables the modern plane to fly with such high loadings.

In the *Travel Air*, the pilot sits in an entirely enclosed compartment, just as do the passengers, but the modern designer has learned how to give the pilot ample vision. There are windows everywhere—in the doors, on either side, sloping ones at the side of the rudder pedals, and in the cupola over the pilot's head which consists of a V-shaped metal frame rigidly attached to a point just back of the pilot's head. The "V" holds two sliding glass windows which, when opened, afford unobstructed vision forward, with little or no air inflow. This is specially desirable for fog, rain or snow flying, when a stationary windshield would cloud vision.

The pilot's seat is cushioned, upholstered, and adjustable both in height and inclination. In his elevated position the line of sight over the engine strikes the ground at about 75 feet ahead of the airplane when at rest. The height and position of the cupola is such that a large range of vision is available to the rear and below the horizontal. This is desirable because in night flying a sight on the line of beacons to the rear is an aid to navigation. In busy air-traffic lanes it is also an advantage to see an airplane which might approach from the rear.

Another excellent cabin monoplane is the Fairchild *FC-2*. Quite as neat and fast as the *Travel Air*, it embodies the advantage of folding wings. The

TAYLOR CHUMMY

Courtesy Taylor Brothers Aircraft Corporation

THE "CHUMMY"

The enclosed cabin is roomy enough to seat two persons side by side comfortably. It is equipped with an 100 horsepower Kinner engine. See also line drawings at left above two wing struts on either side come together to a single hinge at the fuselage. The wings can swing back about the hinge at the fuselage and the rear hinge of the center section of the machine. The safety locks give the same rigidity as in non-folding types and are located in plain view of the pilot. It is surprising how compact the *FC-2* becomes with wings folded back, and this is an important matter when housing costs and hangar space are considered. The *FC-2* has a landing gear which is interchangeable with twin pontoons. For certain private owners, such interchangeability is a great advantage.

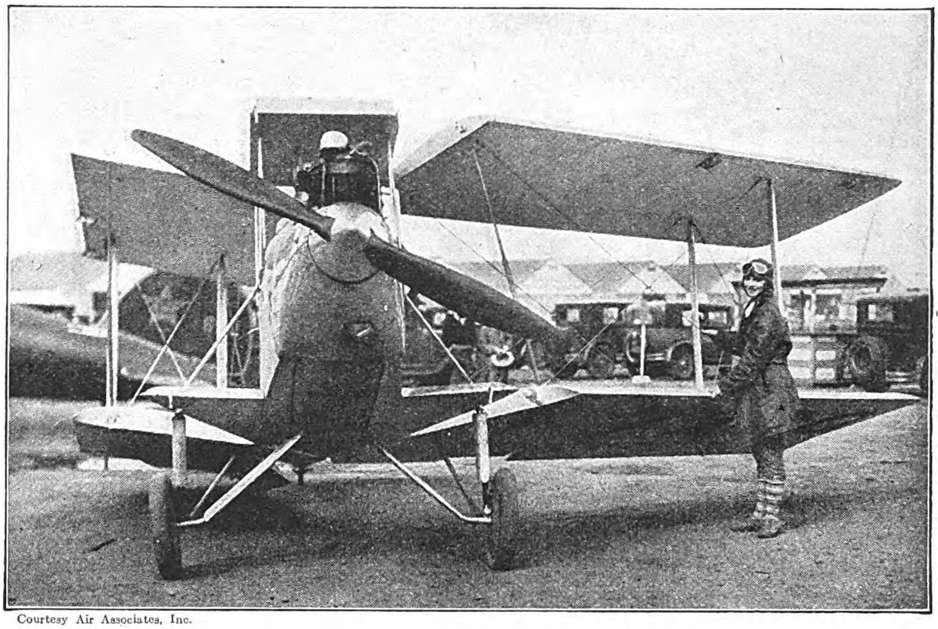
THE large passenger planes now being built by such companies as the Atlantic Aircraft Corporation, Ford Motor Car Company, the Boeing Airplane Company and several others, are much more likely to provide the ultimate in passenger comfort than even the most carefully designed single-engined cabin plane. But the designers of the single-engined cabin plane will, partly of their own volition, partly under pressure of the flying public, constantly improve the design of their cabins. The following are but a few of the desirable characteristics in cabin design:

A special door to the passenger cabin, of easy access from the ground, readily opened, and hinged at its front end so that the blast of air in flying will tend to hold it closed; an emergency exit on the side opposite the entrance door; windows of Triplex glass and designed so as to give perfect vision, even when the passenger is comfortably seated in his chair, extending the entire length of the cabin; heating accomplished by air passing through a pipe around the exhaust manifold or pipe, the air being drawn in at a point where it is not likely to be contaminated by exhaust gas or oil fumes; an attempt at positive ventilation, with all windows closed, air being admitted at floor level, and rising to exits in the top of the cabin.

Positive ventilation is particularly desirable in cold weather, when open windows are likely to produce unpleasant draughts. Positive ventilation also has advantages from the point of view of noise prevention. Silencers are desirable adjuncts and entail far less loss of power in the engine than is commonly imagined. Long exhaust pipes carried well behind the cabin will do practically as well.

But the noise of the propeller, and of the valves in the engine cannot be eliminated. With suitable materials the cabin can be made nearly sound proof, however. The Plane Speaker Corporation, experimenting with Fokker and Sikorsky ships, has found it quite possible to broadcast at heights of 6000 feet. A light, sound-proof cabin was obtained by the use of balsa wool, a fluff wood wool, which has also excellent heat insulating properties. When windows are opened, all the benefits of this sound-proofing disappear. Hence the advisability of positive ventilation.

The airplane designer always seeks to secure better performance by cutting down the outside dimensions of the fuselage. Nothing, on the other hand, is so conducive of passenger comfort as spaciousness. A head room of at least five feet is desirable. With two passengers sitting side by side, a four-foot width would be really comfortable, although a width of three and a half feet is quite permissible.


Courtesy Air Associates, Inc.

THE AVRO "AVIAN"

A small British plane equipped with Handley Page slots, becoming popular in the United States. Folding wings are another added popular feature. See description on page 209

Even in the single-engine cabin plane it should be possible to provide comfortable wicker chairs with head rests. Air sickness is just as unpleasant as sea sickness and passengers should be able to fight its effects by going to sleep, and sleep without head rests is difficult. It is probably too much to expect adjustable chairs as yet.

Cabins should be so designed that passengers have plenty of leg room. A cramped position is far more unpleasant in an airplane than in the automobile where it is always possible to get out and stretch one's legs.

Chairs should not be such as to injure passengers behind them in case of a crash. Their upper portions should be fairly flexible. Safety belts are not often provided in enclosed cabins, but they are useful in gusty weather and when landing—particularly in a bad landing.

Even in a small cabin plane, it seems advisable to have some division or partition between the pilot's cockpit and the cabin proper, although there should be at all times perfect freedom of communication between them. Passengers should either be able to see the pilot's instrument board, or have an air-speed indicator and an altimeter in their cabin.

A simple washroom is a great convenience, particularly for airsick passengers.

Provision for light baggage, in the form of wall racks, should be made. Heavy baggage should always be housed in a separate compartment, as it can be quite dangerous in case of a crash.

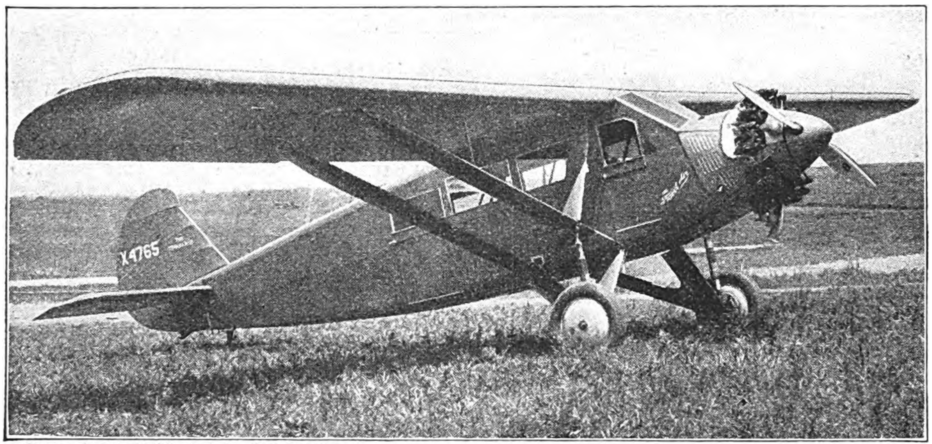
Electric lighting adequate for reading is a great convenience, almost a necessity.

The purchaser of a cabin plane can probably obtain a great deal of amusement as well as information in taking up such points with the pilot-salesman.

THE amphibian—a seaplane provided with retractible wheels, permitting a landing to be made on either land or water—is a type which is of particular interest to the private owner.

Commuting by air is a fascinating idea. Unfortunately, the airport of a great city is generally to be found 10 miles or more from its center, and all the time saved by the aerial commuter is lost in getting from the field to his office. However, in the majority of our great cities, particularly those on the seaboards or on the Great Lakes, water landings may be made within a few minutes' walk from the business center.

For New York, which is more unfavorably situated with regard to its flying fields than any other great city, Clarence D. Chamberlin proposes several landing points for amphibians. One would be at the Battery at the very tip of Manhattan, and a few minutes' walk from Wall Street. Others would be on the Hudson River at 42nd and 33rd Streets, at points readily accessible to the mid-town centers of the city.


Courtesy Travel Air Manufacturing Company, Inc.

"TRAVEL AIR, 6000"

A four-passenger, two pilot, enclosed cabin monoplane with a maximum speed of 120 miles per hour with full load when equipped with a Wright Whirlwind 200 horsepower motor

Residents of Chicago, Cleveland, Boston, and other great cities will rapidly pick out suitable sites for flying boats in their localities.

In the design of an amphibian, certain sacrifices have to be made. A seaplane is never quite as speedy nor as efficient a load carrier as a land plane. The retractible landing gear is a further handicap. Evidently the amphibian is likely to be considerably more expensive than a land plane of similar horsepower. But these disadvantages are more than outweighed for the private owner by the flexibility and general usefulness of the amphibian.

In the preparation of this article, we had the pleasure of interviewing Richard F. Hoyt, Chairman of the Board of the Wright Aeronautical Corporation and a partner in the great banking firm of Hayden, Stone, and Company, which has done so much for the organization and financing of American aviation. Mr. Hoyt has owned a private plane for many years, and is now the proud possessor of a Loening amphibian.

In Mr. Hoyt's opinion there will soon be hundreds—even thousands—of private plane owners. "In a Loening amphibian," said Mr. Hoyt, "there is more comfort and convenience, when flying, than in the most luxurious private car. It is possible to read a newspaper, which is certainly more than one can do in a car. The sense of freedom achieved is wonderful. I can reach Cape Cod in two hours flying, while the rail journey from New York takes six."

Questioned about costs, Mr. Hoyt said that a pilot could be obtained for 100 dollars a week, and that one pilot-mechanic was sufficient for both the operation and the maintenance of his large amphibian. Any man who can afford to own a 75-foot motor cruiser, can afford the most luxurious air yacht. In fact, the seaplane is less expensive, needs a smaller number of men and is much less trouble all around. With an amphibian, housing is much less of a problem than the housing of a large motor boat. With an inexpensive hangar, and a simple runway to the beach, an amphibian can readily be stored away when not in use.

An amphibian of medium size is the Ireland *Neptune*, selling around 14,000 dollars. With a 200 horsepower Wright Whirlwind, the *Neptune* has a speed of 98 miles per hour, an initial rate of climb of 650 feet per minute, a cruising radius of six hours and a pay load of 800 pounds.

The landing gear and tail skid are both of the oleo type, providing a nine-inch movement of the shock absorber on the landing gear. For taxi work, a heavy coil spring is provided. The landing gear is swung up around a horizontal axis, until the wheel takes a position immediately below the leading edge of the lower wing. The operating mechanism of the landing gear is of the irreversible worm and gear type and is enclosed entirely within the wing.

The pilot and one passenger sit in the front of the cockpit. Three passengers sit on a spacious seat in the rear. Thick kapok cushions are supplied, one for each passenger, and these can be readily used as life preservers. A spray strip on the wing and a wide splash and walking board which runs from the bow to the leading edge of the wing, protects the passengers from spray.

Such an amphibian, not too luxurious, is an ideal possession for a sportsman.

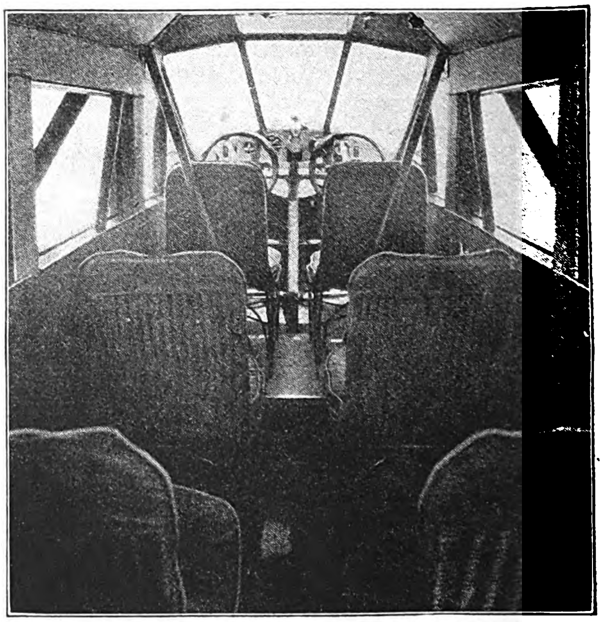
One of the most popular amphibians of the day is the Loening cabin amphibian, now known as the Keystone-Loening Amphibian Air Yacht which is considerably larger, more luxurious, and more powerful and the *Neptune*. It is equipped with a 525 horsepower Wright Cyclone engine.

With this engine its characteristics are as follows: Span—46 feet, 8 inches; length overall—34 feet, 8½ inches; height overall—13 feet, 2 inches; wing area—517 square feet; weight empty—3950 pounds; pay load—1100 pounds; disposable load—1950 pounds; gross weight—5900 pounds; wing loading—11.4 pounds per square foot; high speed—130 miles per hour; landing speed—55 miles per hour; range—550 miles.

With an amphibian it is apparently possible to go to quite a heavy wing loading without undue difficulty. Considering the double handicap of a hull and a landing gear, it is really remarkable what a high performance is attained with this type of craft.

Since the Keystone-Loening cabin amphibian is an expensive air yacht, perhaps our readers will be interested in learning what can be done in the way of finish, passenger comfort, and accommodation, which *Aviation* describes very thoroughly:

The external coloring is high visibility orange in contrast with a black hull and black cowling at the top of the cabin. The wings and tail surfaces are of orange with black struts and bracing members. All external bracing wires



THE "TRAVEL-AIR" CABIN

A spacious interior. Flying is made more interesting to the passengers by the full view of the cockpit and fittings are either polished duralumin or nickel plated steel. The finish resembles that of a yacht and the colors are such that the plane can be seen at a considerable distance.

The cabin is upholstered in the manner of an expensive motor car or boat, with a baggage compartment forward and a small lavatory in a separate compartment in the rear. The interior finish is lavish, fittings are nickel plated, and walnut trim is used around the windows.

The doors on each side are high, and the roof of the cabin above each door slides up to increase the head room for entering or leaving the plane.

Courtesy Atlantic Aircraft Corporation

THE MODERN FLYING OFFICE

A famous designer, A. H. G. Fokker (facing camera) in the cabin of a Fokker tri-motor

The sliding roof in combination with the side windows permits almost any kind of ventilation desired. The side windows slide vertically. An exhaust heater is provided for cold weather, controlled by a shutter in the cabin at the front near the floor. Swivel chairs are provided and a collapsible table can be mounted in the center of the cabin; magazine racks and an automatic cigar lighter are provided.

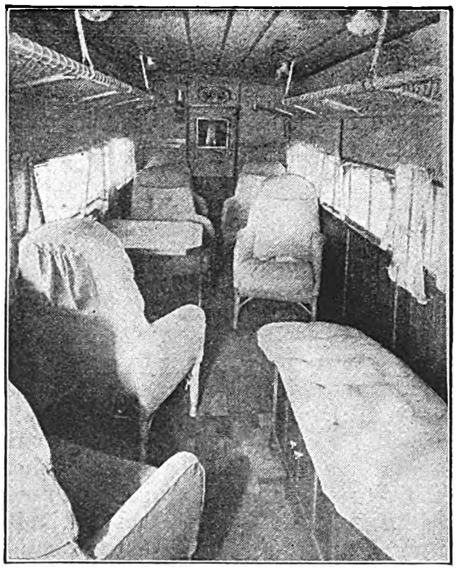
On the Keystone-Loening amphibian, a muffler unit of the Venturi type is used, consisting of three concentric cylinders, the inner two perforated, so that the exhaust gases, entering on one side, whirl at the same time as they expand. The innermost chamber produces the Venturi effect because of its taper. The gasses pass from the chamber between the outer two cylinders to the one between the inner two cylinders and thence inside the inner cylinder, expanding and reducing the noise and flame when passing through the holes from one chamber to another. The Venturi sucks the gases through the system and is said to have increased the speed of the Wasp engine on the ground from 1630 to 1660 revolutions per minute, so that the contention of decreased power due to muffling fails completely when applied to this type. The muffler is above the slipstream and far from the cabin, thus reducing the noise to a minimum.

To reduce the noise further, the cabin walls are padded with balsa wool. A heater of the "muff" type is also included with the exhaust system. It consists of a sheet of metal or "muff" wrapped round the exhaust manifold. An opening on one side receives the air where it comes in contact with the manifold. The air then passes through an opening on the other side which is connected to a pipe leading to the cabin.

THE "muff" is in contact with the exhaust pipe for only about three inches but is said to give a constant current of air to the cabin at about 75 degrees, Fahrenheit, on a moderately cold day.

The air yachtsman has some of the problems of the sailor to meet and similar accessories to provide. Below the engine mount at the front of the body in the Keystone-Loening amphibian is a compartment with ample room for about 300 pounds of baggage. Just behind the door to this compartment is a small compartment containing a collapsible anchor and anchor rope, and a cleat for fastening the anchor rope.

To such marine equipment, particularly in large flying boats, we shall presently see added emergency rations, smoke bombs useful in traveling over lonely waters, a marine rudder, perhaps a marine propeller with auxiliary engine, radio sets which will function when the seaplane is down in an emergency, and perhaps a jury mast with auxiliary sails.



THE INTERIOR OF A FOKKER

Tri-motor *F-10*, showing the comfort that modern airplanes are providing

Just as in the automobile, there is no end to the accessories and equipment which may be purchased. A well-equipped instrument board such as shown in our photograph should carry:

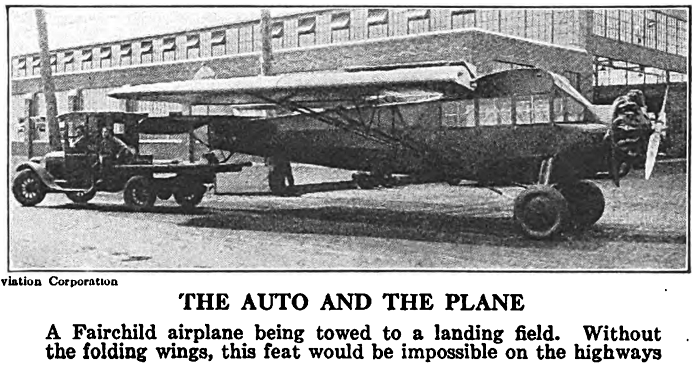
Oil pressure gage
Oil temperature gage
Fuel pressure gage
Fuel level gage
Tachometer
Clock
Altimeter
Air speed indicator
Magnetic compass.

FOR cross-country flying it is convenient to have a drift and ground speed indicator and a bank and turn indicator, map case, et cetera. For night flying, navigation lights, landing lights, and parachute flares are essential. For flying over long stretches of water a collapsible life boat and a smoke-producing apparatus contribute to safety.

Radio sending and receiving equipment is a luxury that probably few private owners will invest in as yet.

On the plane itself, wheel brakes, a metal propeller, automatic fire extinguisher for the engine compartment, and a dump valve for the gasoline are desirable.

As a rule, the purchaser of a modern



Courtesy Fairchild Aviation Corporation

FAIRCHILD MONOPLANE

One of the popular monoplanes with a 410 horsepower Wasp motor, capable of 140 miles per hour, carrying four passengers

THE AUTO AND THE PLANE

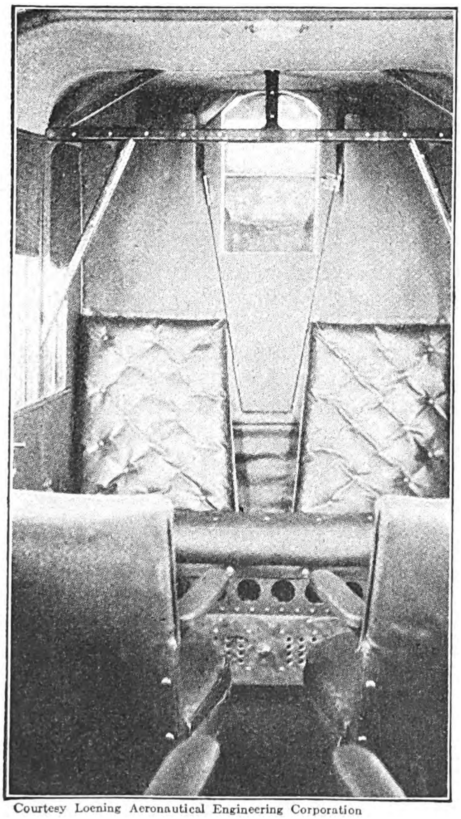
A Fairchild airplane being towed to a landing field. Without the folding wings, this feat would be impossible on the highways plane will find the minimum necessary equipment already installed. To the possible number of accessories and the money that may be spent there is, as in the case of the automobile, practically no limit. The private owner should confine himself to what is strictly necessary at first and only expand his equipment as his flying objectives become more ambitious.

IN air-transport operations, cost accounts are now kept with considerable accuracy. In private and school flying, there is a tendency to disregard costs. Therefore the figures given in a recent issue of *U. S. Air Services* for operations conducted by Robert Rhea, of Colorado Springs in a school known as Pikes Peak Flying School will be informative reading to the prospective private owner, even if interested in a plane of quite another type than that used by Mr. Rhea.

Two Alexander *Eaglerock* OX-5 engined, two-seater planes were used for school purposes. The planes cost 1700 dollars each, the engines 450 dollars each.

For a period extending from September 17 to December 1, 1927, the following are given as the per hour figures:

Estimated Items	
Plane depreciation per hour	$2.40
Engine depreciation per hour	1.50
Hangar rent per hour	.85
Total Estimated items	$4.75

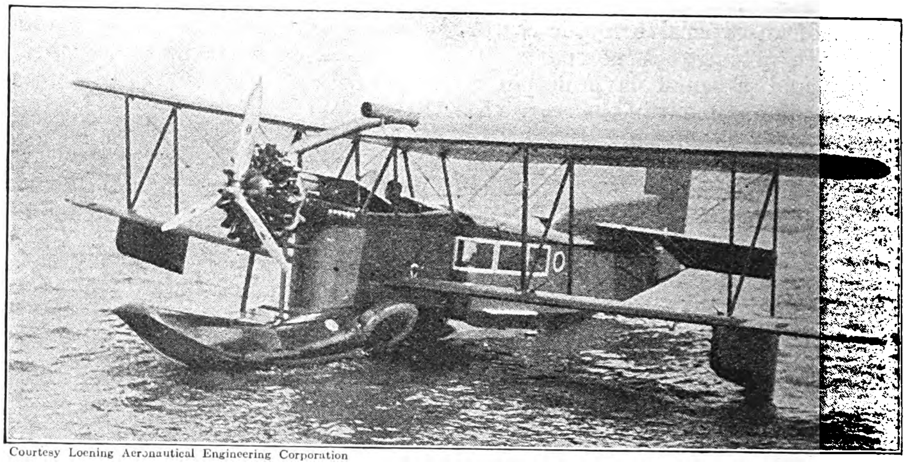


Courtesy Loening Aeronautical Engineering Corporation

INTERIOR OF AMPHIBIAN

Closing off the pilot's cockpit from the cabin increases the comfort of passengers

Actual Items	
Gas and oil	$1.36
Mechanic's Salary	2.08
Pilot's Salary	5.00
Advertising	.50
Postage, et cetera	.53
Repairs — engine and plane	3.61
Other Expenses	.30
Total actual flying items	$13.38
Total cost per hour	$18.13



Courtesy Loening Aeronautical Engineering Corporation

THE LOENING AMPHIBIAN

A military type amphibian converted for use in the commercial private field. The exhaust ont he top of the wing incorporates a silencer of unusual design to reduce exhaust noises

The above figures represent 200 hours of actual flying. Hangar and field rent were 25 dollars a month for each plane.

THE depreciation figures were purposely set high, so as to permit the use of new equipment at all times and increase the margin of safety. This was justified by results. Even though each student made cross-country flights of 45 miles, and 3000 flights were made, not a single forced landing was recorded.

Estimating the cruising speed to be 85 miles an hour, the cost per mile was 22.4 cents. Disregarding depreciation, pay of pilot and mechanic, and other items not taken into account by the private owner, the cost per mile figures out to be 6.8 cents.

This low figure will not apply generally. Planes even of the 90 horsepower class will now cost more. A large cabin monoplane will involve far more expense all around. A private owner may have a bigger repair bill than a rigidly run school, but to one who is accustomed to a fairly expensive automobile, such an outlook will not be terrifying.

The prospective owner may also be interested in a more direct method of figuring costs, based on practice at Curtiss Field, Long Island.

For a plane in the 100 horsepower class, hangar space will cost 35 dollars a month. Washing down the plane, draining oil, and other servicing will cost another 20 to 25 dollars a month.

The frequency of engine overhaul depends on the amount of flying. An overhaul every five to six months at a cost of 75 dollars for the engine (to include cleaning cylinders of carbon, grinding down valves, et cetera) is a reasonable estimate. Overhaul of the plane should run to about the same figure, but need not be so frequent. Crash insurance may be computed at under 20 percent per annum of the value of the plane. Depreciation should be figured at 33 per cent per annum. Ten dollars a week is a generous allowance for fuel and oil.

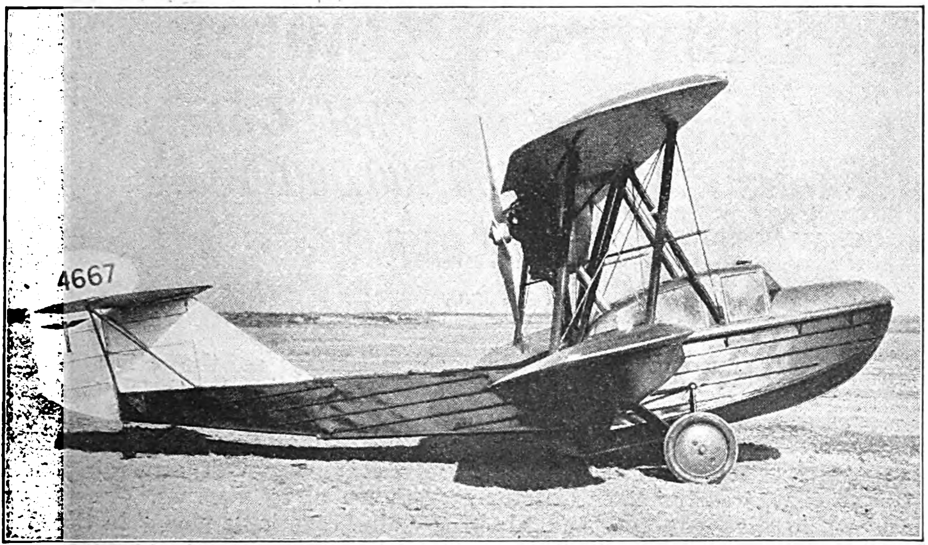
With careful use, the owner-pilot of a 3000 dollar plane should be able to carry on indefinitely with an expenditure of something like 2000 dollars per annum.

The expenses of an owner who has his own hangar and repair shop, and his own pilot will, of course, be very much heavier. The cost of a small hangar is not very great, and the equipment needed is not large—a bench, a vise or two, a kit of tools, and a few spare parts. But even the owner who has to rely entirely on his own resources will find his expenses fairly heavy.

IT seems much more practical to station one's plane at a regular flying field, where "garage" and service are readily available.

While there have been and are now in existence in the United States, a large number of aviation clubs, with club rooms for social purposes, aeronautical libraries and frequent meetings for the discussion of aviation problems, there have been few attempts to maintain real flying clubs.

To enthusiasts about to form a flying club, the experiences of Mr. Rhea will again be interesting. After his successful experience with his school, he organized a non-dividend corporation under the name of Pikes Peak Flying Club. The following rates were established:



Courtesy Ireland Aircraft, Inc.

THE IRELAND AMPHIBIAN

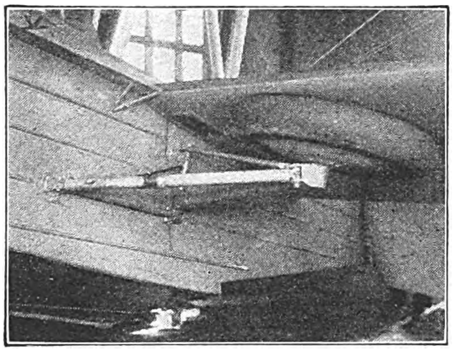
A plane, equally at home on land or sea. The wheels are retracted under the wing when the amphibian is to land on water. An ideal all around plane for the private owner

25 dual instruction lessons of 25 minutes each	$250.00
30 solo tickets, good for 20 minutes each	150.00
Hop tickets	5.00

Appointments for dual instructions were carefully made, instruction having precedence in the morning, hops in the afternoon. A bond of 1500 dollars was required for solo work, and 250 dollars on dual instruction, as an insurance against carelessness or misuse of equipment. Quoting from *U. S. Air Services*, "Gross revenue in the first two months from student work and hop tickets was 9000 dollars. Out of each hop ticket, Captain Zimmerman was paid $1.25 and the mechanic 35 cents. Starting with one plane, a second *Eaglerock* was bought within four weeks. Then a small office-club-house was erected on the field. After 14 weeks' operation the club owned 7000 dollars worth of equipment and owed only 1600 dollars. It will not be long until the enterprise will be self-supporting and free from debt."

This experience is very encouraging to a group seeking to form a club.

IT is a sign of the times also that co-operative ownership of the club plane is appearing. Thus the members of the "Wise Birds Club" have developed an original scheme for securing the advantages of airplane ownership, with costs reduced by division among several men. The members of "Wise Birds Club" are five prominent business men: Frank W. Blair, president of the Union Trust Company; William B. Stout, designer of the Ford Metal Airplanes; Newton Skillmann, president of the O and S Bearing Company; Carl H. Keller, president of the Contractor's Equipment Company; and Charles B. Bohn, president of the Bohn Aluminum and Brass Company, all of Detroit. These gentlemen shared equally in the original cost of a *Stinson-Detroiter*, which was about 11,000 dollars. When a member of this group uses the plane, he pays for the gasoline and oil, and pays for depreciation on an hourly basis. At the end of the month, maintenance and repair bills are divided among the members in proportion to their flying hours.



IRELAND LANDING GEAR

The land supplement of the amphibian landing gear is shown here retracted

London *Flight* has a special section of its weekly issue devoted to private flying. The following reports of the doings of flying clubs make most interesting reading.

"Well-known fliers give special exhibitions. Clubs give jolly dinners and dances. Prominent citizens give planes to local clubs. 'The Hampshire Aeroplane Club' made its total of 692 hours in one year with only two machines. Sixty members are flying solo, 32 of whom have been trained *ab initio* by the instructor, Flight-Lieutenant Thomson. There is not a single accident to record. Finally, the social conditions have been improved. There is now a fine club-house.

"The Suffolk Aeroplane Club started last August. Its work for the year was done without official financial assistance. Only one machine was in use, and 99 hours were flown. A large sum has already been subscribed towards the purchase of another machine. Its need is very urgent. Membership of 50; soloists trained—four. There were no fatalities. Lady Bailey is the President.

"The Scottish Flying Club trained 40 members, gave many dances. The purchase of another machine is one of the present objectives and a Club Badge has been designed and will be issued shortly at a nominal charge to cover the cost.

"The Cinque Ports Flying Club carried 350 joy-riders on Good Friday to replenish its finances, famous test pilots giving the hops."

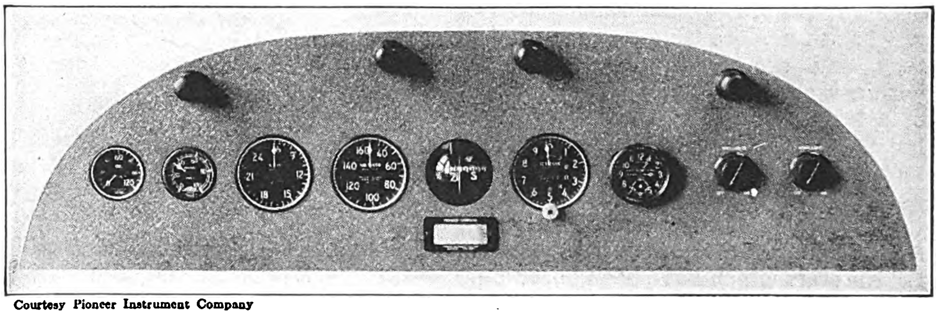
WE have given these disjointed notes on English private flying because they point the way to what we ought to see and shall see in the United States.

The increased safety of the airplane and the great increase in the number of landing fields are now leading many sportsmen and other well-to-do men to think of private ownership.

Young America wants to follow Lindbergh and fly. Flying schools all over the country are besieged with applicants. As soon as a young man has learned to fly, he wants to have his own plane.

Private ownership is also of interest to doctors in sparsely populated districts, ranchers, prospectors, surveyors, and to men in many other occupations.

It can be predicted without much hazard, that there will be both a steady and a rapid increase in the use of airplanes for private flying.



Courtesy Pioneer Instrument Company

PIONEER INSTRUMENT BOARD

An oil pressure gage, an oil temperature gage, an engine tachometer, an airspeed indicator, a compass, an altimeter, and a good clock are necessary adjuncts to a plane of any type

Does Our Universe Rotate?

Accumulated Evidence Indicates that the Whole Galaxy of Billions of Stars Rotates in About 100,000,000 Years

BY HENRY NORRIS RUSSELL, PH. D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

IF one looks over the table of contents of the latest volume of one of the astronomical periodicals he is likely to find one or more papers which deal with the "rotation of the Galaxy." This topic, although quite a live one at present, has not been discussed before in these columns.

The world has known for a century that the great mass of stars which forms the Milky Way is flattish in shape, with a diameter several times its thickness. The most natural explanation of such a shape is that the great cluster is flattened by its own rotation—as the earth itself is, but to a very much greater degree. Theoretical calculations based on this idea are no novelty but to test their results by observation is hard.

IN the first place the rotation of the Milky Way must be exceedingly slow. An elementary calculation shows that the rotation period does not depend on the size of the cluster or greatly on its shape, but mainly on the density with which the stars are scattered within it. We know about how massive the stars are, and about how far apart, and it follows at once that a single revolution of the galaxy must require at least a hundred million years.

This seems at first sight to dispose of the matter as hopeless. But the rate of a whole turn in a hundred million years corresponds to more than a second of arc in a century; and astronomy has at its disposal observations of the stars which run back for more than a century and are accurate well within a second. Taking the average of a large number of these we might hope that the efforts of the random motions of the stars would average out, and those of the general rotation of the system remain.

But here another difficulty appears. All the stars which have been observed, belong to the Milky Way and share the general rotation. What fixed standard can we find from which to measure their motion? Our ordinary observations tell us where the stars are, compared with the celestial equator (which is nothing but the plane of the earth's equator carried out into the heavens). If the earth's axis always pointed exactly in the same direction, that would give us the standard of reference. But everyone knows that it does not; it shifts steadily so that the pole which it marks out on the sky revolves about the pole of the ecliptic (fixed by the earth's orbit) over a little less than 26,000 years. From the ordinary human standpoint this precessional motion is slow, but from our present point of view it is extremely rapid. Before anything can be said about the rotation of the Galaxy, this shift of the earth's axis must be most carefully measured and accurately allowed for. Fortunately this can be done, although the calculations are long and wearisome; and so we have the earth's orbit to measure from instead of its equator. But even this shifts slowly as the other planets change the orbit by their attraction.

Mt. Wilson Observatory

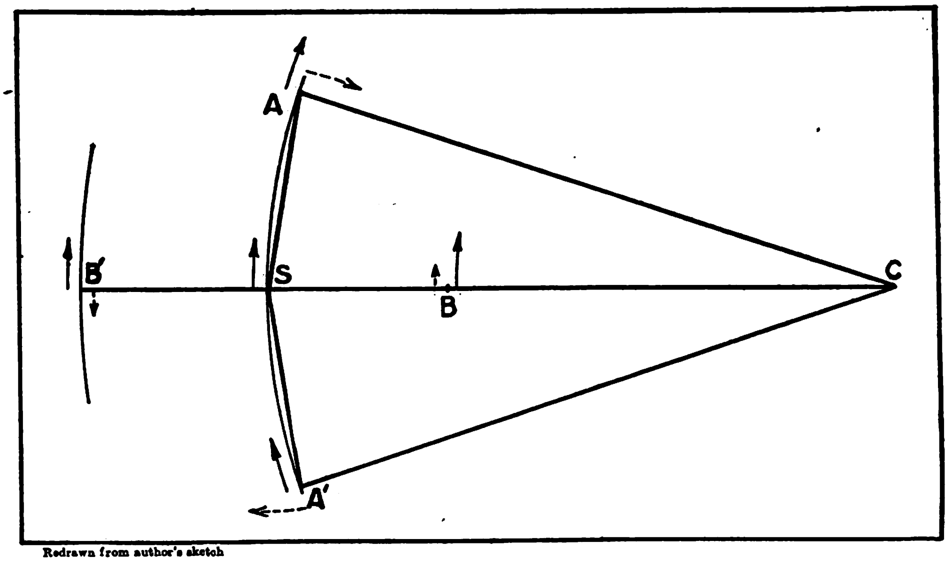
A ROTATING UNIVERSE

Spiral nebula M-33, in Triangulum, possibly resembling our own universe, the Galaxy. Lundmark believed he found this spiral nebula to be slowly rotating

Once more a mass of calculations are necessary, but this time we find ourselves at last with something fixed from which to measure. There is a certain "invariable plane" in the solar system—which may be regarded as a sort of average of the planes of all the planetary orbits — and this is unchanged despite all the perturbations of the orbit which result from the mutual attractions of the planets. Our calculations may be framed so as to reduce our observations to this as a standard, and here we have something which can be shifted only by the attraction of the stars themselves. This, however, can be calculated and turns out to be far too small to worry us.

SEVERAL investigators have gone through the heavy work of calculation, using different groups of stars whose motions have been accurately determined, and all agree that there is evidence of a very slow rotation of the whole system of stars in the opposite direction from that in which the sun and moon circle the heavens. The calculated periods of rotation vary fairly widely from 200 million to more than 400 million years, but they are of quite the magnitude that was to be anticipated from dynamical considerations. Indeed, it is incredible that the Milky Way as a whole should rotate much faster than this; if it was started going as fast as one turn in 50 million years, the stars would be sent flying away into space so fast that the attraction of the whole mass could not pull them back again.

So far, so good. But where is the center around which the rotation takes place? This looks like a harder question still, but it has been solved by two able young continental astronomers, Lindblad of Sweden, and Oort of Holland, in a remarkably pretty fashion. It is probable, as we told in these columns last month, that the



Redrawn from author's sketch

ATTEMPTING TO "SEE THE WOODS, FOR THE TREES"

If we had some convenient way to back away from our galaxy a few million, million, million miles it might be seen as a whole. Unfortunately we must figure it out from where we are

great star swarm of the Milky Way has a central condensation in which much of the attracting mass is contained. The outlying stars would then pursue orbits around this mass as the planets do about the sun. As in the case of the planets the more distant bodies with larger orbits would take longer to go around—so much longer, indeed, that their velocities in miles per second would be smaller the farther from the center they were. This would produce curious effects upon the apparent motions.

Let us, for the sake of simplicity, consider our stars moving in circular orbits around the center C (upper drawing) of the Galaxy. (Motion in elliptical orbits introduces complications which, however, average out in the mean of a large number of cases).

LET us represent the Sun, S, moving in its huge orbit around C in the direction and at the speed indicated by the arrow. Let A be a star at the same distance from the center but ahead of the sun on its track. Its orbital motion will be at the same rate, and hence the whole triangle C S A will swing around the center uniformly. The line S A, therefore, will deflect slowly to the right and A, as seen from S, will appear to sweep slowly to the right in the heavens as is indicated by the dotted arrow. For a star A′, on the sun's track and behind it, the apparent motion will also be to the right and at the same rate.

Consider now the star B, between the sun and the center. Its real motion (shown by the solid arrow) is in the same direction as that of S, but faster. It will therefore overtake S, and for an observer moving with the sun, it will appear to drift to the *left*, as the dotted arrow shows. A star outside the sun at B′ will be moving more slowly; the sun will overtake it, and it again will drift apparently to the left. These backward drifts will be slower than the forward ones at A and A′, so that the average for stars all around the circle comes out in the correct direction.

When the observed motions of the stars are examined in detail, it is found that they show exactly the behavior which our diagram predicts.

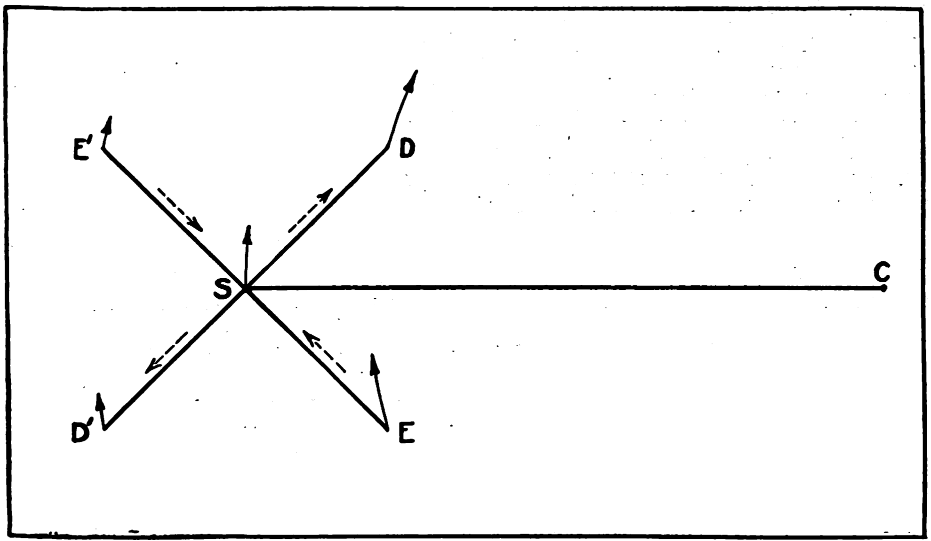
In the opposite quarters of the heavens the average motion is forward (that is, in the sense of the general rotation already discussed). In the regions 90 degrees from these it is backward but considerably slower.

A quite independent test may be obtained from the spectroscopic observations of the radial velocity of the stars (their approach or recession). It is evident from the diagram that stars A A′ will not be changing their distance from the sun. No more will those at B and B′, since their motions are at right angles to the line of sight. But suppose we have a star at D in the lower diagram. It is moving faster than the sun (as the arrow indicates) and thence will recede from it. On the other hand, the star at E, which is also moving faster than the sun, will approach it. A star at D′ (opposite to D) will move more slowly than the sun; the sun will run away from it and once more it will appear to recede; while one at E′ will be overtaken by the sun and approach it. These motions are indicated by the dotted arrows which show whether the distance is increasing or decreasing. Here again we get an effect which is the same in opposite parts of the Milky Way and reversed in direction at points 90 degrees from the first. But in this case the regions where the effect is a maximum are shifted 45 degrees from those which show a maximum effect on the proper motions.

ONCE again the observations reveal just such an effect, changing signs in the way predicted by theory; and what is more, showing a shift of about 45 degrees from the direction given by the proper motions.

One further test remains. The direction toward the center C, (first diagram) is evidently in the middle of one of the regions B and B′ when the apparent drift of the stars is backward. Which one of these two opposite regions should be taken cannot be determined without some additional evidence. But this is forthcoming—one of these directions is very nearly that of the great star clouds in Sagittarius. There is a great deal of independent evidence—some of which we spoke of last month—to show that the center of the Galaxy is in this direction, and the agreement is close enough to afford further support to the hypothesis of rotation.

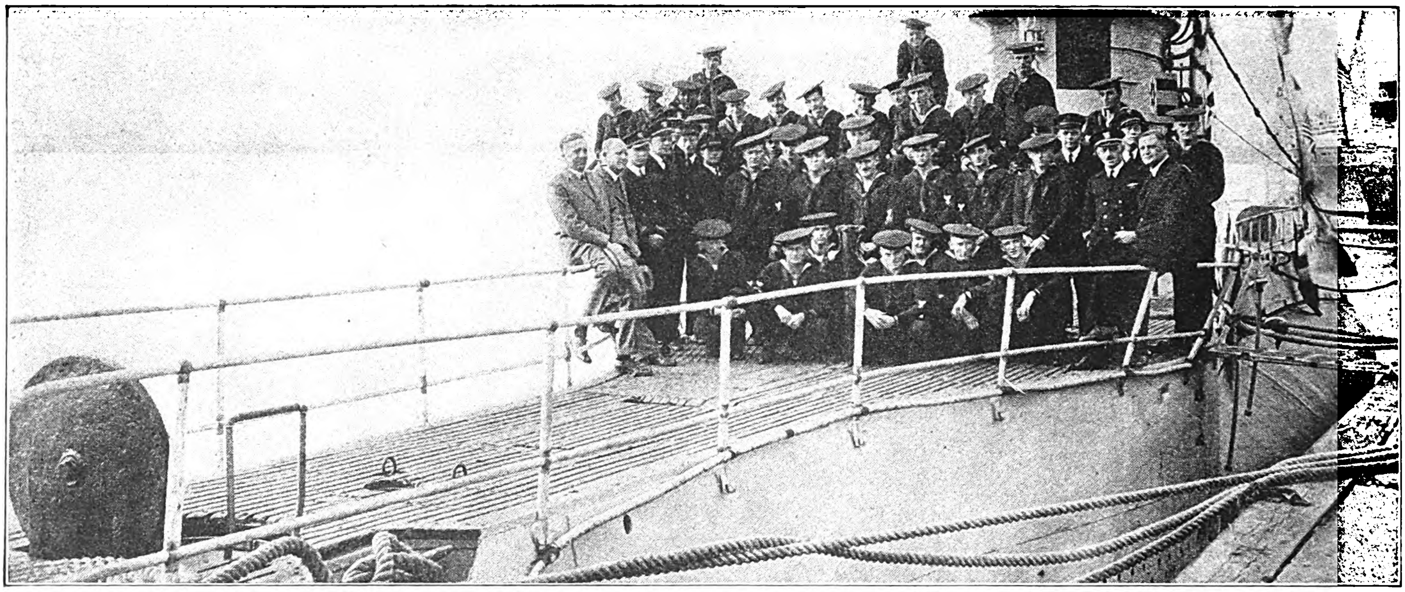
The cumulative weight of all this evidence is such that belief in an actually observable rotation of the Galaxy is now very generally accepted.



Redrawn from author's sketch

THE SECOND SOLUTION AGREES WITH THE FIRST

Both drawings are explained in detail in the text. As in many problems that first seem hopeless, a solution was forthcoming after attack. A scientist is essentially a kind of detective



SCIENTISTS, OFFICERS, CREW, SUBMARINE

The personnel of the expedition, assembled on the deck of the *S-21* at the Washington, D. C., Navy Yard immediately on their return from a two months' trip to southern waters for the determination of gravity at sea. Dr. Meinesz is seated on the rail at the reader's right

Weighing the Earth From a Submarine

The Purpose and Scientific Significance of the Determinations of Gravity at Sea Recently Given Wide Publicity by the Press

By WILLIAM BOWIE, C.E., Sc.D.

President, Section of Geodesy, of the International Geodetic and Geophysical Union
In Charge, Division of Geodesy, United States Coast and Geodetic Survey
Author of "Isostasy"

DR. F. A. VENING MEINESZ, the great geodesist of Holland, who is the only man in the world to design an apparatus for determining gravity at sea with a satisfactory accuracy, has to his credit a string of gravity stations encircling the earth, and has just completed an expedition into the Atlantic, the Caribbean Sea, and the Gulf of Mexico, on an American submarine, the *S-21*, assigned by the Secretary of the Navy. Gravity observations were made over the Nares Deep to the north of the island of Porto Rico, the Bartlett Deep, lying to the south of Cuba, and the Sigsbee Deep, in the Gulf of Mexico.

There are many deeps, or troughs, under ocean waters of which we know much; but what caused them and whether they are permanent features of the ocean bottoms are problems unsolved. In or near them some of the greatest earthquakes occur—why, we do not know. We hope the values of gravity obtained by Dr. Meinesz and his colleagues may throw much light on these strange depressions of the earth's surface.

For many years the value of the earth's attraction, or gravity, has been determined by noting the time it takes for a pendulum to make its swing. The faster the movement, the greater the value of gravity. Until recently the pendulum could be used only on land where a firm support could be obtained.

IN 1923 Dr. F. A. Vening Meinesz, a member of the Goedetic Commission of Holland, started on an epoch-making expedition from Holland to Java, in the East Indies, on a Dutch submarine, with a complicated pendulum apparatus for determining values of gravity at sea. This apparatus was the outcome of Meinesz' gravity measures in Holland, where the land is in many places unstable. There are microseisms due to the force of wind and to the waves of the North Sea, which seriously affect the time of swinging of the usual type of pendulum. He found that by swinging two pendulums simultaneously in the same plane but in opposite phase he could obtain a record from which the effect of the earth tremors would be eliminated.

It was only a step to use the new apparatus on a boat after having found that it could be used on unstable land. But the boat would have to be much steadier than usual. The roll and the pitch of the boat in even a moderate sea would toss the pendulums around and prevent making good records. This difficulty was obviated by using a submarine submerged to such depths that it would be free from the wave action at the surface. By experimentation it was found that the water is quite still at depths below about 70 feet.

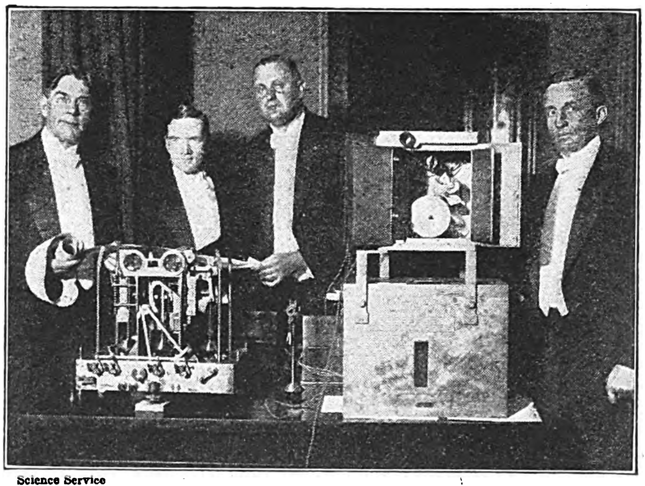
The voyage to Java was highly successful. Many observations were made, which for the first time furnished accurate values of gravity over ocean waters. Later on Dr. Meinesz redesigned the apparatus in order to make it especially adaptable to sea work. In the present apparatus there are three short pendulums swinging in the same vertical plane in almost the same period of time. The pendulums are enclosed in a case, which is mounted in a cradle, which in turn is suspended from gimbals. The gimbals rest on a frame which is made fast to an upright beam or to the deck of the submarine.

The pendulum case and the photographic apparatus used for recording the pendulum swings, are fastened rigidly together. A series of mirrors and prisms attached to the pendulum heads and to the supporting framework receive rays of light and reflect and refract them on to the moving film. There are actually rays coming from the mirrors of five pendulums, all in the same case. Three of the pendulums swing freely in the same plane. In a parallel vertical plane is a fourth pendulum which is heavily damped to prevent any movement except that caused by the tilting of the case; while a fifth one, also heavily damped, swings at right angles to the others.

THE photographic records from the three pendulums swinging in the same plane enable one to derive the times of oscillation of what may be called two hypothetical pendulums which are free from the effect of the horizontal acceleration of the apparatus. The records from the fourth and fifth pendulums show the inclinations of the plane of the three swinging pendulums to the vertical and the inclinations of the pendulum supports in that plane. From the photographic records from these two pendulums the effects of the tilting and of the amplitude of oscillation are computed and applied to the periods of the hypothetical pendulums.

Observations are made during a period of about 30 minutes, while the submarine is held at an even depth. In order to maintain this uniformity the boat is run at a slow speed, for otherwise it would either rise to the surface or sink. The value of gravity obtained is therefore the average along a line one or two miles in length.

The times of oscillation of the pendulums are obtained by comparing the oscillations with two high-grade chronometers, whose seconds' beats are recorded photographically with the pendulum observations. The chronometer rate is determined from radio time-signals sent out by a number of astronomical observatories, such as the Naval Observatory at Washington. Corrections are applied to the observed gravity in order to reduce the value to what it would have been at the surface of the sea. The value changes one part in a million for ten feet of depth. Another correction is needed to eliminate the effect of the speed of the ship on the centrifugal force due to the earth's rotation. The gravity value obtained is greater when traveling westward, and is decreased when the boat moves eastward.



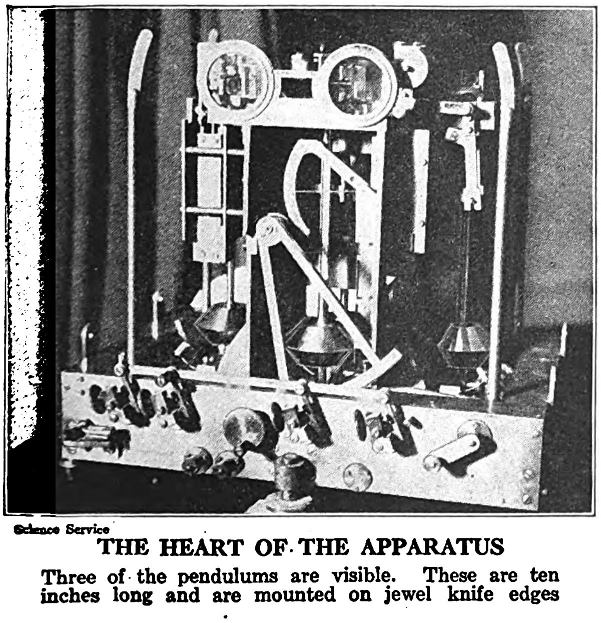
Science Service

SCIENTISTS, APPARATUS, OFFICIALS

Left to right: Secretary Wilbur; gravity apparatus; Capt. Freeman; Dr. Meinesz; recording apparatus; Dr. Wright

The latitude and longitude of the place of observing is determined by the navigator of the ship. This is a matter of importance since the value of gravity increases with an increase in latitude; and besides, those making geophysical investigations must know the relation in geographical positions of gravity stations to the irregularities of the ocean bottom.

THE 1923 voyage of Dr. Meinesz on the submarine *K II* of the Dutch Navy extended from Holland to Java via the Mediterranean Sea, Suez Canal, Red Sea, and the Indian Ocean. Upon his return to Holland he made some important changes in his apparatus which occurred to him as a result of his experience in the voyage to Java. His next important voyage was on the *K XIII* from Holland to Java across the Atlantic and Pacific Oceans, via the Panama Canal. This voyage occupied 200 days, of which 114 were spent at sea, while for the others the submarine was in port. Among the stops en route were the Azores, the Canaries, Curaçao, Panama, San Francisco, Honolulu, Guam, Japan, and Manila.



Science Service

THE HEART OF THE APPARATUS

Three of the pendulums are visible. These are ten inches long and are mounted on jewel knife edges

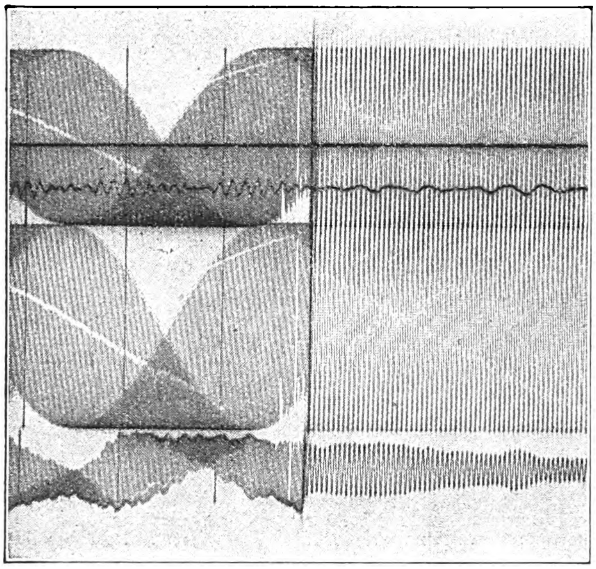
In February, 1927, Dr. Meinesz made his next voyage, lasting several weeks, in the Indian Ocean to the south of Java. This voyage was undertaken to obtain values of gravity over the Java trough or deep, which for many years has been a puzzle to geologists who have tried to explain the great irregularities of the earth's surface in the East Indies region. Dr. Meinesz' latest voyage, made recently in the submarine *S-21* of the United States Navy, carried him into the Atlantic, the Gulf of Mexico, and the Caribbean Sea.

Dr. Meinesz' results on his four voyages on Dutch submarines attracted the attention of the scientific world and naturally the geophysicists and geologists of other countries had hopes that the submarines of their navies might be used for gravity work at sea. In the spring of 1928 informal conferences of Dr. A. L. Day, Director of the Geophysical Laboratory of the Carnegie Institution of Washington, and Captain C. S. Freeman, Superintendent of the United States Naval Observatory, resulted in Secretary Wilbur of the Navy promising a submarine if the Carnegie Institution would invite Dr. Meinesz to come to America with his pendulum apparatus.

Dr. Meinesz accepted Dr. Day's invitation and the submarine was made ready. He arrived in Washington the latter part of September, made observations at the gravity base station at the office of the Coast and Geodetic Survey in that city, and then installed the gravity apparatus in the *S-21*, which had been brought to the dock at the Washington Navy Yard.

DR. F. E. WRIGHT, a member of the Geophysical Laboratory, and Mr. E. B. Collins, of the Hydrographic Office of the Navy, joined Dr. Meinesz on the voyage of the *S-21* in order to assist him in the observations and computations and to become thoroughly familiar with the gravity apparatus, and how to observe with it should our Navy undertake other voyages for gravity observations after Dr. Meinesz returns to his hone.

After the pendulum apparatus was in place, the *S-21* was visited by Secretary Wilbur, Admiral Hughes and other officers of the Navy, and by many of the scientific men of Washington. In spite of the cramped quarters and the smallness of the boat, favorable response would have been



A TYPICAL PHOTOGRAPHIC RECORD

Seven values, representing times of swing, tilting of apparatus, and temperature of pendulums, are shown

made by many of those present had there been a call for volunteers for the voyage.

The *S-21*, with Lieut. J. L. Fisher in command, left the dock on the afternoon of October 2nd, without the booming of cannon but with all good wishes of those scientific workers of America who knew of her mission. She sailed out into the Potomac and headed toward the sea on a voyage to conquer earth secrets, and to throw light on some of the most baffling of earth problems.

THE submarine was joined at the mouth of the Chesapeake Bay by the Eagle boats *No. 35* and *No. 58*, commanded by Lieut. Comdr. T. L. Nash and Lieut. Comdr. L. R. Moore, respectively. The voyage was planned in a most efficient manner and all went well. The Commander and other officers and the members of the crew of the *S-21* took intense interest in the work and did their part well. They received the highest commendation and praise from Dr. Meinesz at the conclusion of the voyage.

The *S-21* tied up at the Washington Navy Yard dock on November 27th. All on board were happy, although tired, after two months of intensive work in close quarters and much buffeting by rough seas. A splendid, epoch making expedition was ended, and the results obtained are of great scientific value. We feel that this is only the beginning of the use of American submarines on gravity surveys.

THE earth is a globe about 8000 miles in diameter, flattened at the poles and with a surface of about 197,000,000 square miles, of which 140,000,000 are covered by water. The surface is represented by high mountains and plateaus, with the greatest elevation above sea level slightly more than 29,000 feet, and by ocean basins having great ridges, shelves and troughs. The greatest depth found is more than 35,000 feet in the trough just to the east of Mindanao, an island of the Philippine Archipelago.

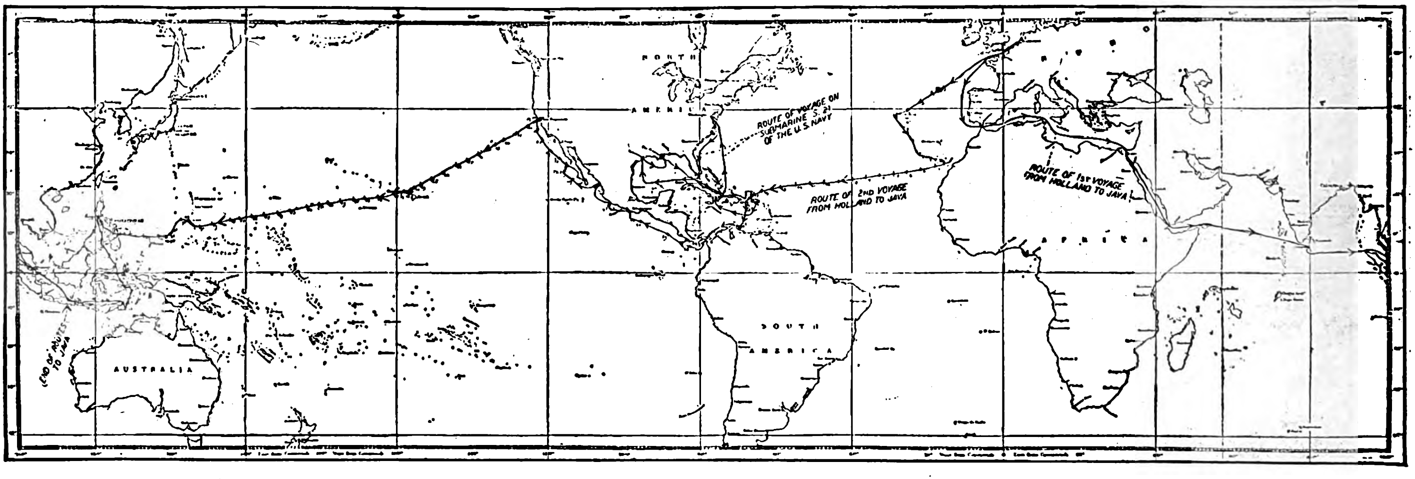
The earth's surface is not fixed for all time. This we know from the sedimentary rocks on the mountain slopes and on the plateaus, thousands of feet above the sea, which contain the fossil remains of sea animals. What caused the uplift is one of the greatest problems of geology.

A few decades ago we had scant data concerning the earth, and consequently hypotheses advanced to account for what was observed at the surface had to be based largely on speculation. We know more now, but still not enough. From collected tidal, seismological, and variation-of-latitude data the definite conclusion has been reached that the earth is solid throughout with a rigidity equal to that of steel; or that, if solid for only a part of the way from the surface, the outer part must be even more rigid than steel.

However, the forces studied, from which the data regarding the interior were derived, act for short times. A body may resist deformation when a force is applied for a short time, but it may act as though it were plastic to the same or a smaller force which is long continued. The sum of the mutual attractions of the particles of matter composing the earth is so vast that no known substance in a mass equal to that of the earth could maintain any other than a globular form. This is the reason for the approximately round shape of the earth's surface. But is the earth strong enough to maintain the continental masses as extra loads, and can it resist the bulging up of the ocean floors because of the deficiency of mass above them? The answer to these questions is that the irregular surface of the earth is caused by the differences in density underlying the different parts of the surface. The differences in elevation do not cause great strains in the earth's materials.

THE investigations carried on by members of the United States Coast and Geodetic Survey have shown that the outer material of the earth under continents, down to a depth of about 60 miles below sea level, has densities depending on the elevation of the surface. The smallest density is under the highest mountains and the greatest density below the coastal planes. By inference it was decided that the density of the material below the ocean should be still greater.

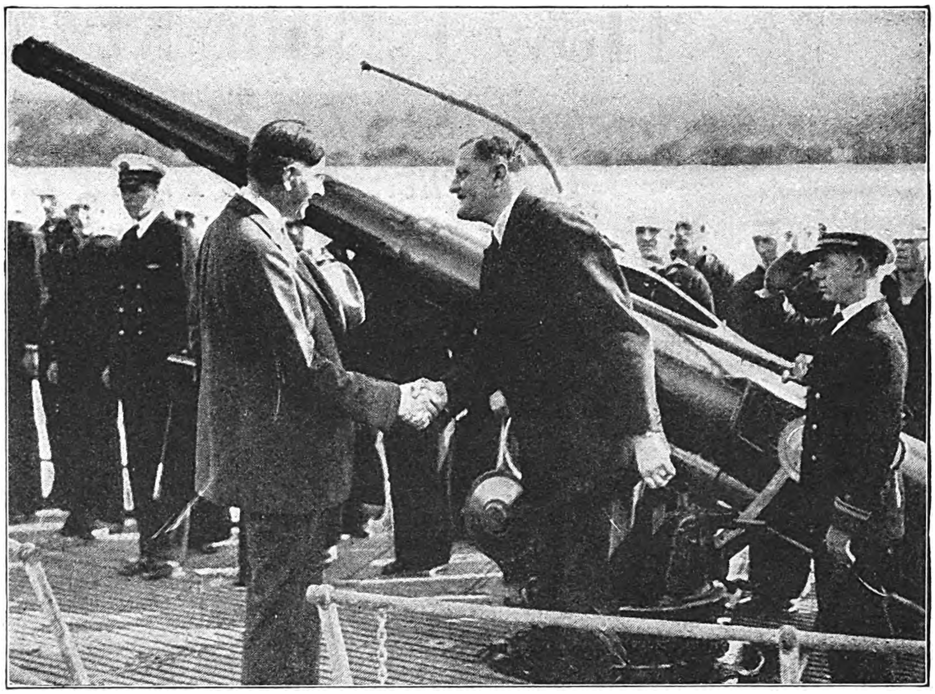
The data used in these investigations were collected on continental areas and on a few ocean islands. The most important data used were values of the earth's attraction, or gravity. If the earth were a perfect sphere and were not rotating, gravity would be the same at all places. If its surface were



NORTH
AMERICA
ROUTE OF VOYAGE ON SUBMARINE S-21 OF THE U.S. NAVY
ROUTE OF 2ND VOYAGE FROM HOLLAND TO JAVA
ROUTE OF 1st VOYAGE FROM HOLLAND TO JAVA
AFRICA
SOUTH
AMERICA
AUSTRALIA
END OF ROUTES TO JAVA

ROUTES OF THE THREE IMPORTANT VOYAGES OF THE MEINESZ APPARATUS

The first voyage was taken in 1923, from Holland to Java, on a Dutch submarine; the second was westward from Holland to Java, also on a Dutch submarine; the latest was in the West Indies on a submarine made available to science by Secretary Wilbur



SECRETARY WILBUR GREETS DR. MEINESZ

On the deck of the U. S. Submarine *S-21*, just before sailing from Washington, D. C., for the Gulf of Mexico and the Caribbean Sea for gravity work, as described in the text

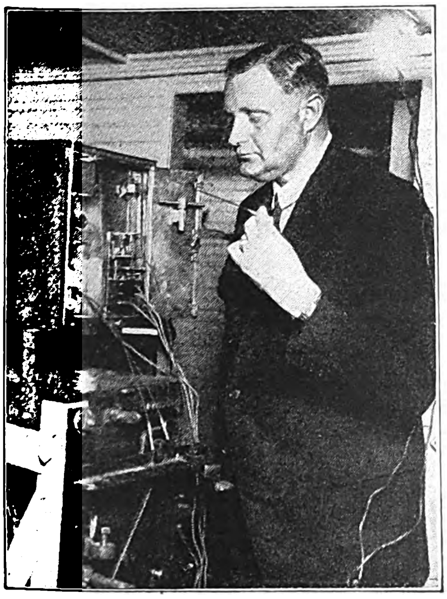
in the form of a spheroid, or a distorted sphere, due to the rotation, gravity would gradually and regularly increase from the equator to the poles.

The water surface of the oceans is very nearly a spheroid, but the solid surface departs considerably from the spheroidal shape. Therefore, gravity should follow very closely the law of change which applies to the ideal earth. The differences are caused by several factors. The value of gravity decreases with the height of the station above sea level. We know the law of this change and can apply corrections. Then it would seem that the attractive effect of the continental and island masses should be determined and applied as corrections. Also the deficiency of mass in the ocean waters should be taken into account. All of this has been done, but there remained large differences between the observed and the theoretical values.

THE next step was to assume that the continents were held at high altitudes because the earth's materials under them are light, just as the ice of the lower part of an iceberg holds the top of the berg out of the water. It was also assumed that the bottoms of the oceans were underlaid by material heavy enough to hold down the ocean basins.

Computations, based on this theory, were made which showed that the assumptions are substantially true, and that these light and heavy materials extend to a depth of about 60 miles below sea level. This condition of equilibrium is called *isostasy*. Dr. Meinesz' gravity work at sea is designed primarily to test the isostatic condition of the earth's crust under the oceans. His data will also be used to make a better determination of the shape of the sea level surface of the earth, that is, the earth's "figure."

The results of his observations lead us to the conclusion that the isostatic condition exists under the oceans to about the same degree that it does under continents. We may now assert that the earth's crust is in isostatic equilibrium. It would remain so were it not for disturbing influences, the most important of which is the erosion of material from land areas, and its transportation by streams and rivers to the margins of oceans and inland seas, where it is deposited in vast quantities. This transfer disturbs the equilibrium. The crust sinks down under the sediments and it rises up under the areas of erosion. In order that this may be, the sub-crustal material must be plastic to forces acting for hundreds or thousands of years. This must be so since isostatic equilibrium exists.



DR. F. A. VENING MEINESZ

With his gravity apparatus at the United States Coast and Geodetic Survey

THE gravity data enable us to determine by an indirect method the difference in weight or mass of one part of the earth's crust as compared with other parts. We do not especially care to know how much mass there is in any particular prism of the earth's crust or the density of the rock at different depths. But we do want to know whether one unit prism is heavier or lighter than some other one. When this information is obtained we can then draw more accurate conclusions regarding the cause or causes of the irregular surface of the earth.

The first voyage of Dr. Meinesz on a submarine gave us gravity values on the Atlantic, the Mediterranean Sea, and the Indian Ocean, and showed that the isostatic equilibrium exists under the places at which he made his observations. His other voyages furnished data which proved that the crust under the mid-Atlantic and the great water area of the Pacific is composed of heavier materials than exist in the crust under continents.

DR. MEINESZ has already observed at about 250 places, thus making it possible to show that the ocean basins are depressed by the greater density of the crustal material underneath them. His contribution to the earth sciences is inestimable.

However, his gravity observations obtained on the Dutch submarine were made at widely separated points and mostly in what may be called open waters. There are needed many stations closely spaced in certain critical areas, such as that represented by the West Indies. It was for this reason that Dr. Meinesz was invited to come to this country to work in that region on an American submarine. The data obtained on this expedition are not in final form at the time of writing this paper, but they will surely show much regarding the densities of the crust under the West Indian region, and the degree to which isostasy exists there.

Since it has been found, by extensive gravity determinations at sea in different parts of the ocean areas, that isostasy is a universal condition of the earth's crust, the students of the earth will have to modify or abandon many of the generally accepted conceptions as to the causes of earthquakes and volcanoes, the formation of mountains and plateaus, and the origin of the continents and ocean basins.

How I Built My Glider

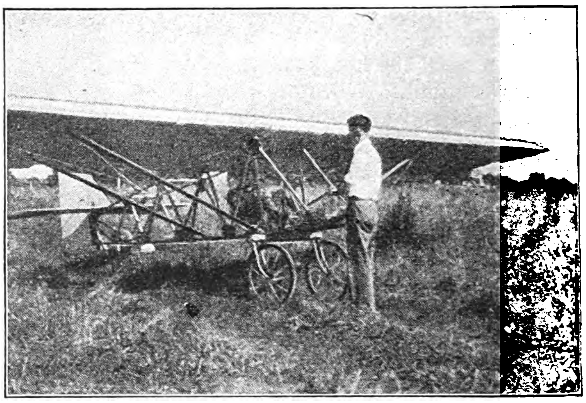
An Amateur Tells of His Successful Experiment in Constructing and Flying a Glider

By EDMUND JAMES

As far back as I can remember I have always been intensely interested in flying, but for economic reasons and having been a country yokel far from the centers of learning where aviation was making history, it remained but a dream. I can look back, even now, and see the old Wright flying machine as it circled the Fair Grounds at our County Fair and thrill clear to my toes. But dreams are dreams and it takes a long time for some to come true.

With the impetus that Lindbergh gave to flying, and the various succeeding oceanic flights, my dreams again came to the front, but lack of necessary funds made it seem out of the question. Just about that time the *Literary Digest* re-printed an article from the SCIENTIFIC AMERICAN on the soaring flights of the German gliders, and so was born the idea of building a glider.

With the idea came difficulties. How should I begin? Where could I secure the necessary blue prints and instructions? It was some search. First I went to the library and was informed that they didn't even know what a glider was, much less have data pertaining to its construction. However, they did have books on aviation, and Page's "Aeroplane Construction" proved a great help. Quarters and half dollars to various magazine advertisements brought back the usual run of sucker literature, all generalities; for additional dimes and quarters, more generalities. Finally the search ended with the acquaintance of a Mr. Formvaldt who, through German translations and other data he had accumulated, made up an excellent set of plans and building detail, and so I began.

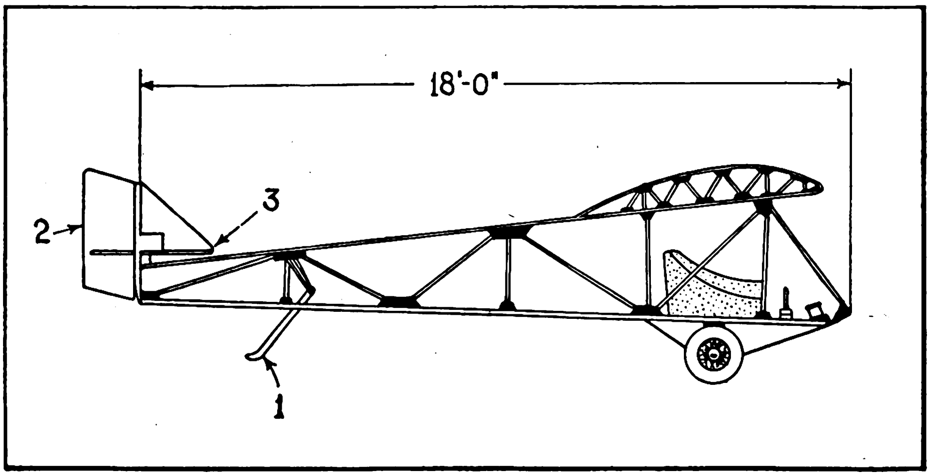


READY FOR THE TAKE-OFF

It proved easier to take-off and fly than to land safely. The wheels made it difficult to stop on a slope

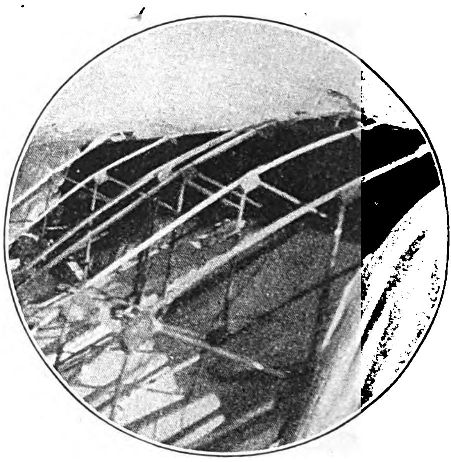
Gathering materials proved to be quite a task and inexperience considerably increased the cost. The purpose of this article is to keep some of the other boys who are interested in building gliders on the straight and narrow path of dollars and sense.

CLEAR spruce is expensive and almost unobtainable in the sizes used, although much to be preferred. Soft pine is the most suitable substitute; both from structural strength and workability it proves very satisfactory. Ash was used for the front end of the fuselage, splicing just to the rear of the pilot's seat.



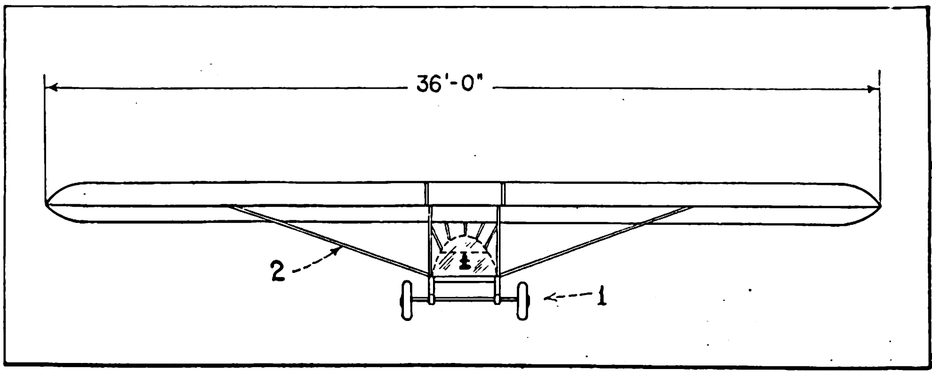
CONSTRUCTION DIAGRAM

Side view showing design of (1) tail skid, (2) rudder, (3) stabilizer and elevators



WING STRUCTURE

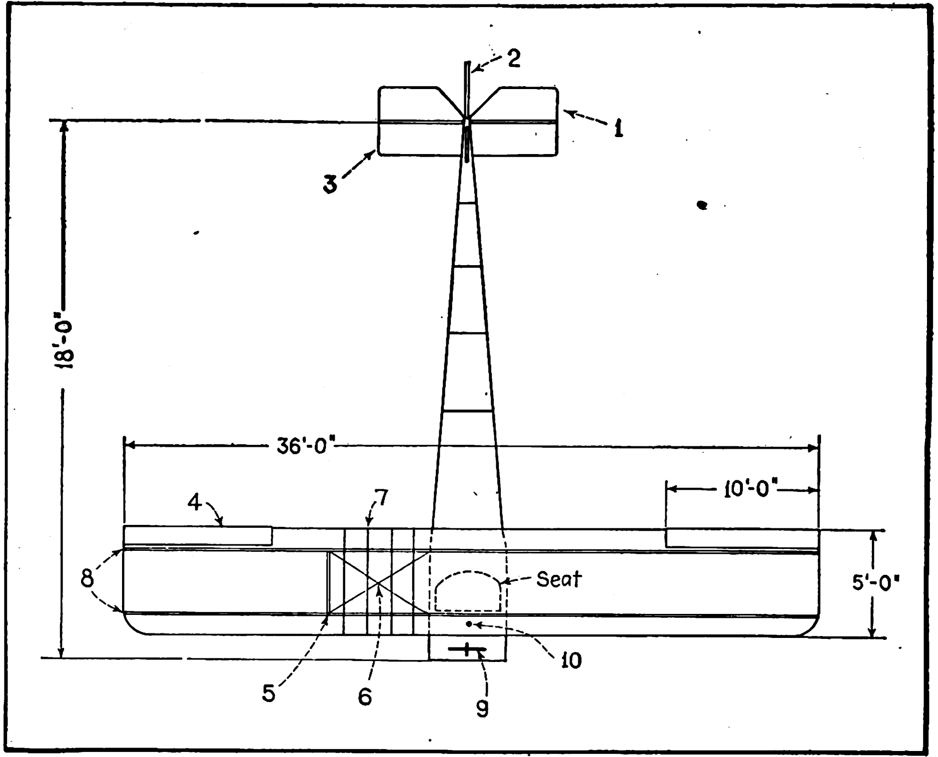
The ribs were spaced a foot apart and fastened to the spars with nails and glue



VIEW FROM FRONT

This line drawing shows the position of (1) wheels, axle, and undercarriage; (2) struts

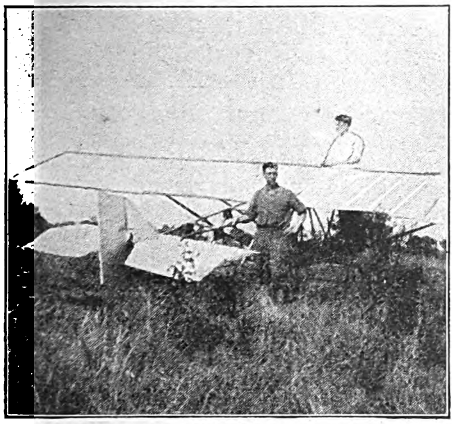
On just what part to begin is up to the builder. I chose the wings. I took a board six feet long by 12 inches wide and with ¼ x ¼ pine made a rib jig on a pattern of wing similar to that used on the Junkers plane but with more sweep to the tail, giving the wing a cord of five feet six inches. Then to the task of making 36 ribs. Radio packing cases were secured from the radio dealers who are usually glad to get rid of them, and were used for the plywood gussets which secured all joints on both sides, being glued and nailed.



All line drawings from sketches furnished by the author

SPECIFICATIONS FOR THE HOME MADE GLIDER

Diagrammatic sketch of Edmund James' glider, showing design and position of (1) elevator; (2) rudder; (3) stabilizer; (4) ailerons; (5) compression struts; (6) internal guy wires with bicycle-spoke turn buckles; (7) ribs; (8) spars; (9) rudder bar; (10) stick, movable four directions for ailerons and elevators. The covering is given three coats of airplane "dope"



THE COMPLETED GLIDER

Wing and fuselage can be easily assembled after being taken to the field

After the wing ribs were made came the fashioning of the wing spars. Each was 18 feet long, ⅞ of an inch in thickness and tapered from a depth of eight inches near the fuselage to two inches at the ends. The use of a solid spar was a mistake as it made the glider too heavy for use on calm days. German box type construction would have saved many pounds but I learned of this only after the wings were made. The spars were laid across a couple of horses and ribs spaced a foot apart were slipped on and fastened with nails and glue. Cross wires were used as internal braces, with sheet metal fittings made from 16 gage sheet metal. Bicycle spokes were fashioned into turn buckles and worked nicely. The compression struts were made from ⅞ x ⅞ pine and were located between every fifth rib. The trailing edge was inserted with ¼ x ¾ pine and the wings were now ready for covering. The fuselage came next and was made of ⅞ x ⅞ pine and ash of bridge truss construction 18 feet long and ending in a vertical wedge on which was mounted the tail assembly of rudder elevator and stabilizer. The ailerons were assembled from the end of the wing ribs for 10 feet on the outer end of each wing.

After each of the separate parts was made it was assembled in the skeleton and the metal fittings were made for attaching wings and tail assembly to the fuselage, struts, et cetera. Each piece was patterned with paper much as a dressmaker would fit a form and then cut from the metal. Care was taken to build in such a way as to facilitate dismantling and assembling. Both wings and fuselage were so arranged as to be loaded on to a Ford touring car for quick transportation from home to the field, and can be completely assembled in thirty minutes. Incidentally, all the metal for fittings was salvaged from a junk pile.

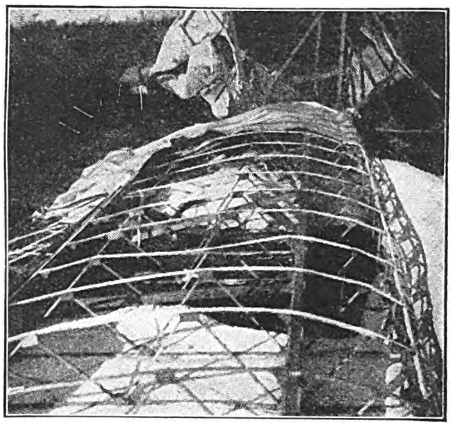
Ordinary sheeting of an inexpensive grade was used for covering and proved to be the easiest part of the work, or my added enthusiasm at seeing it near completion made it seem so. It was then given three coats of airplane dope. Then came the great day.

IT is seldom one achieves success with his first attempt. This was especially true in my case since construction of this kind was strictly out of my line; but with the second attempt it raised majestically to a height of 25 feet and sailed gently down the slope for 150 feet. If I had had the wings of a horse fly I could not have been more pleased, but further analysis in actual practice proved many glaring errors. It was much too heavily constructed and could be made much lighter without in any way sacrificing strength or flying ability.

In order to facilitate the take off, which was accomplished by towing with an automobile, wheels were substituted for the skiis. This is not considered good practice however, as was proved by its wrecking in a clump of trees through inability to stop quickly enough after landing on a down grade.

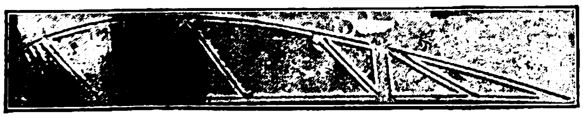
Gee, but it was great sport though, while it lasted, and quite inexpensive if one forgets the two months of patient labor.

I have laid down the keel of a new one of much better design, thanks to Mr. Formvaldt. It won't be long now!



FRAMEWORK OF THE WING

This view, taken after the wreck, shows the structural design of the wing

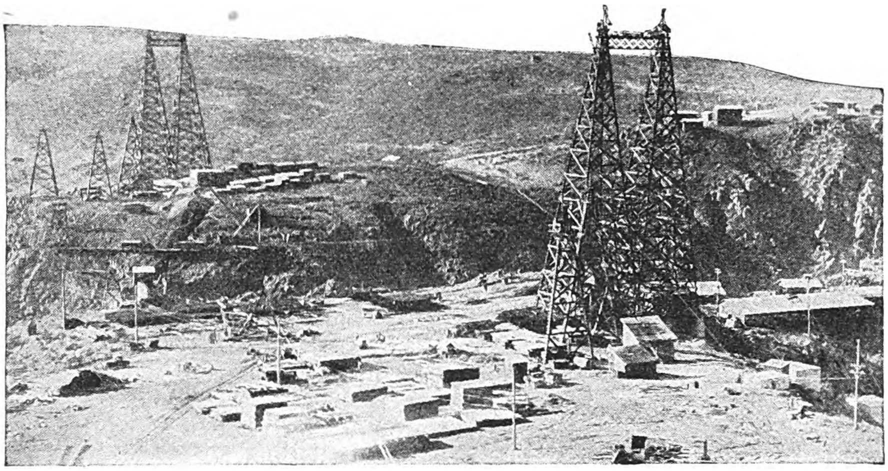


THE RIB JIG

This model was laid out on a board 10 inches wide and six feet long

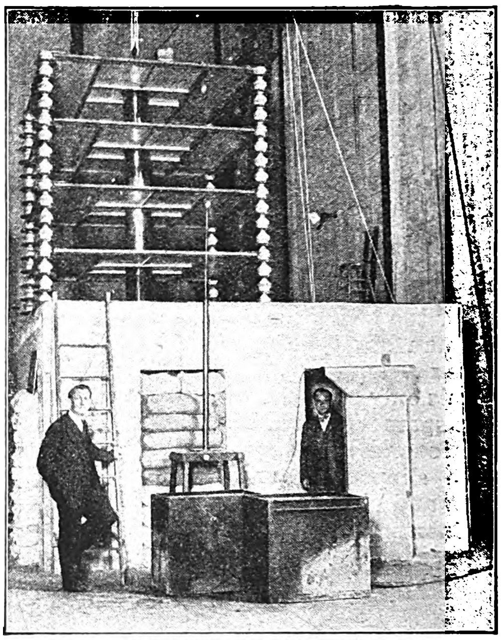
¶ *The foregoing article is presented to our readers with but little editing. In its own way it reflects the enthusiasm of the aeronautical novice, and shows what can be accomplished by even the tyro when the urge is strong. While Mr. James has given only the outline of his work, and but few of the details, we feel that the essence of the subject has been conveyed, and that others can follow in his footsteps.*

Camera Shots of Scientific Events



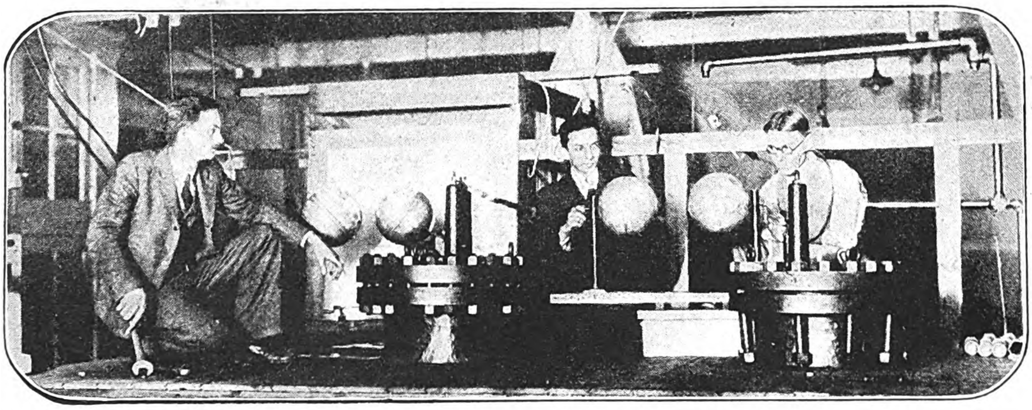
FOR IRRIGATING THOUSANDS OF ACRES

What is said to be the most important agricultural enterprise in Mexico has just been started in Lower California, 14 miles south of the International border. It is a dam for impounding sufficient water to irrigate 50,000 acres of land. The dam will cost 4,000,000 dollars, will be 230 feet high and half a mile long, with an elbow bend in the center. The photograph shows the equipment being set up preparatory to the beginning of construction work



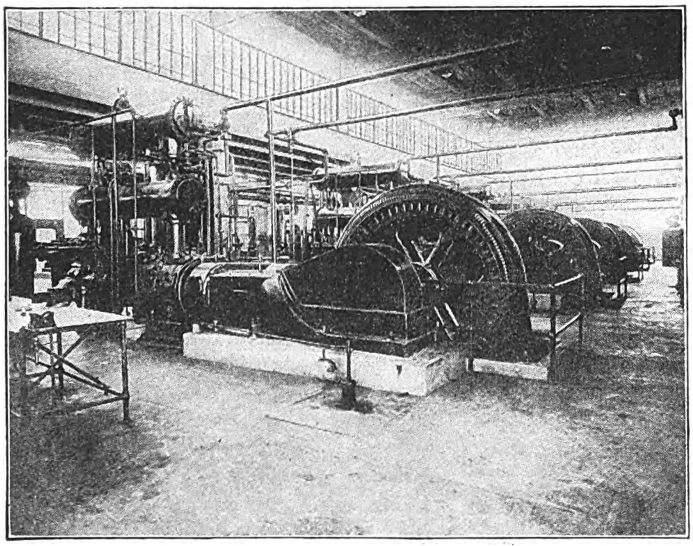
SAND-BAG PROTECTION

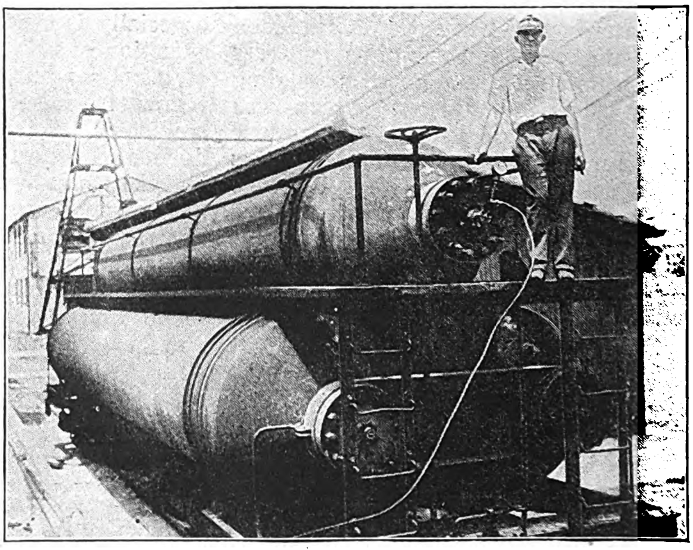
The world's largest X-ray tube at the California Institute of Technology, Pasadena, emits stray rays that would be harmful to scientists operating it, so it has been shielded by a heavy emplacement of sand-bags. Beside the 15-foot tube are Professors C. C. Lauritson and E. C. Watson



◄ SMASHING ATOMS

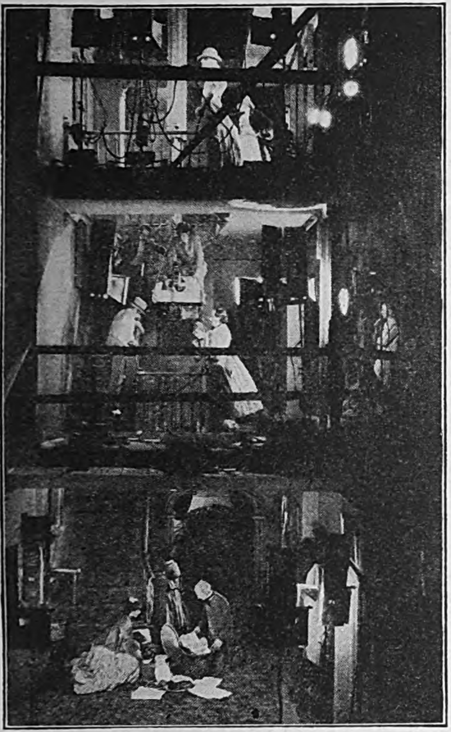
Dr. M. A. Tuve, Dr. Gaviola, and Mr. Hafstead, scientists of the Department of Terrestrial Magnetism of the Carnegie Institution, Washington, D.C., beside the 5,000,000-volt equipment developed for the study of atomic structure. With it they have produced the highest voltage ever obtained—5,200,000 volts. The instruments, including condenser, spark gap, and measuring gap are shown in this photograph





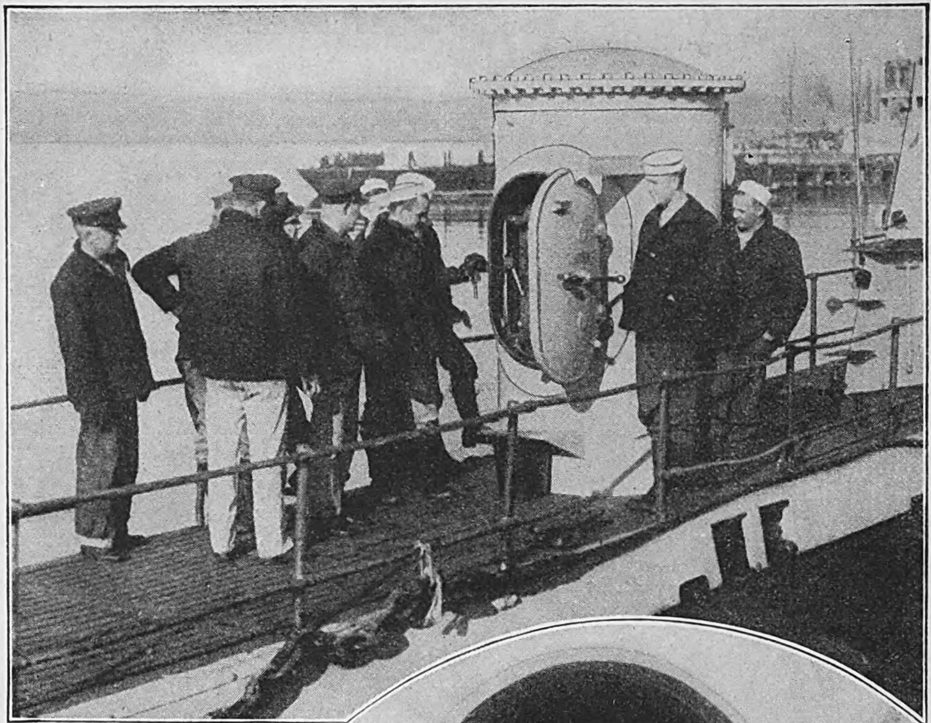
HELIUM PRODUCTION AND TRANSPORTATION

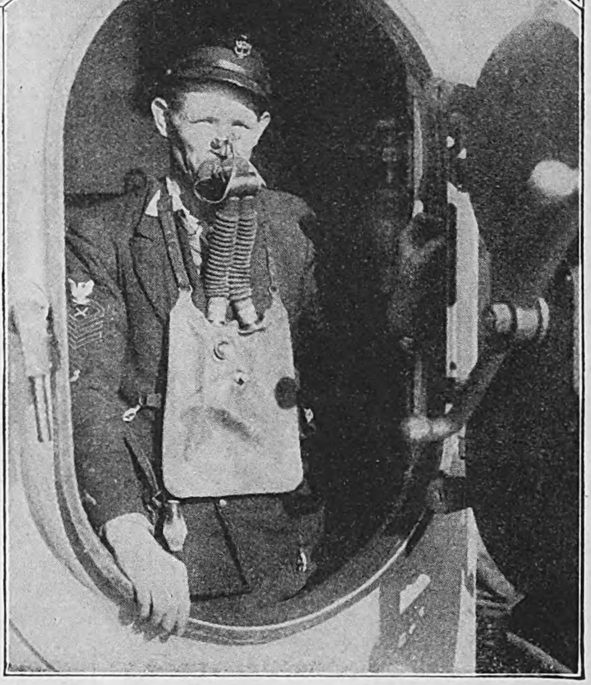
At the left are shown some of the mighty compressors at the Federal Helium Production Plant in the natural gas fields near Forth Worth, Texas. These pumps are required to exert a pressure of as high as 3000 pounds per square inch in recovering this rare gas from natural gases. At the right is a specially designed tank car used for transporting helium to naval airship stations. It carries 200,000 cubic feet of gas at a pressure of 2000 pounds and weighs 100 tons



THREE-FLOOR "MOVIE" SET

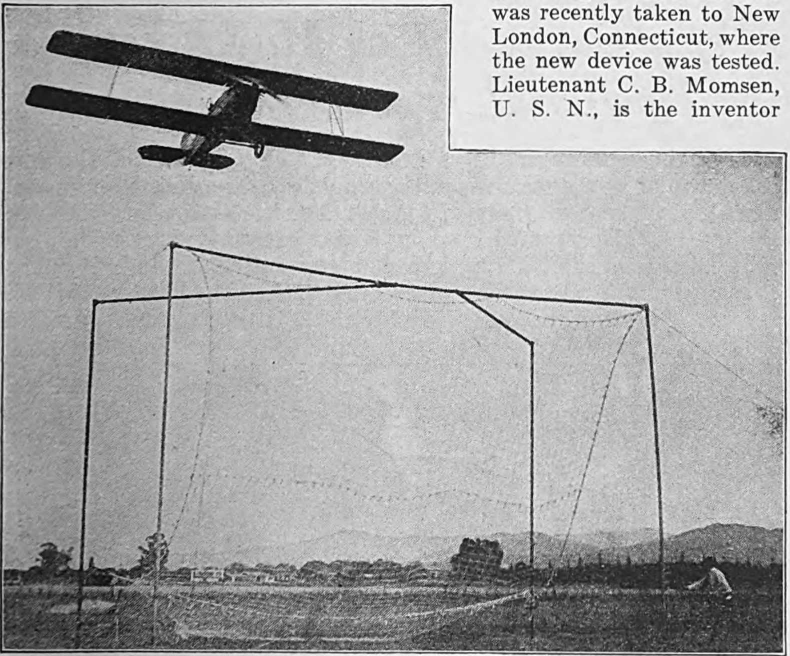
Metro-Goldwyn-Mayer built this set for a scene in "The Actress." With it, a "shot" may be taken to show what is going on in the stair well of three floors. The director and cameraman may be seen preparing to take a "shot" from the second floor





"ARTIFICIAL LUNG"↑→

The re-conditioned submarine *S-4*, which was rammed and sunk in December, 1927, showing the escape hatch from which members of the crew may escape by using the "artificial lung." The submarine was recently taken to New London, Connecticut, where the new device was tested. Lieutenant C. B. Momsen, U. S. N., is the inventor



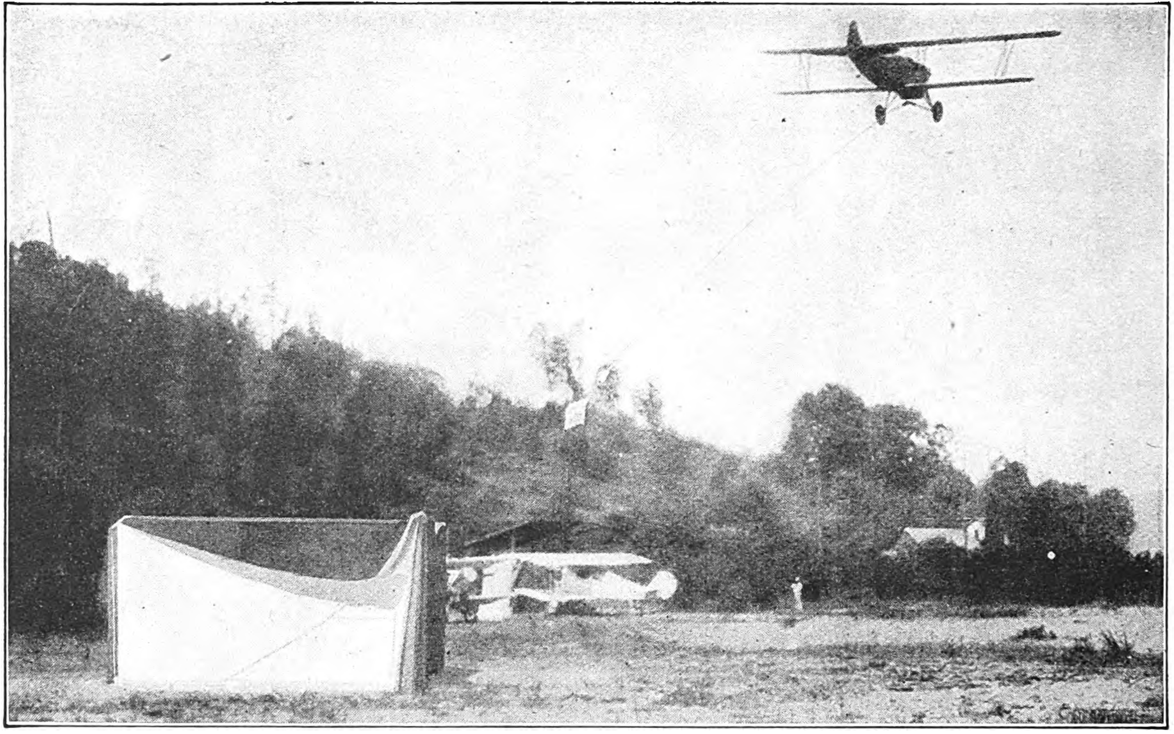
AIR MAIL DELIVERY

Tests of a new device for delivery of air mail while the airplane is in flight, invented by Bolton Jones and M. G. Burnham of Whittier, California, have been made and the device is said to have proved successful. A mail bag is let down on a rope where it dangles until it makes contact with sharp blades on the framework of the apparatus. These blades cut the rope; the bag drops into the net, and it may then be retrieved by members of the ground force. This apparatus has no provisions for taking on mail

FIRST SUCCESSFUL FLIGHT
OF AN AIRPLANE
ORVILLE WRIGHT

AT KITTY HAWK →

Orville Wright, Senator Hiram Bingham of Connecticut, and Miss Amelia Earhart on the sands at Kitty Hawk, North Carolina, beside the tablet commemorating the first air flight made there 25 years ago by Orville Wright. The tablet was unveiled recently when persons prominent in aviation made a pilgrimage to this scene of the Wright brothers' early experiments



THE PICK-UP SYSTEM IN ACTION

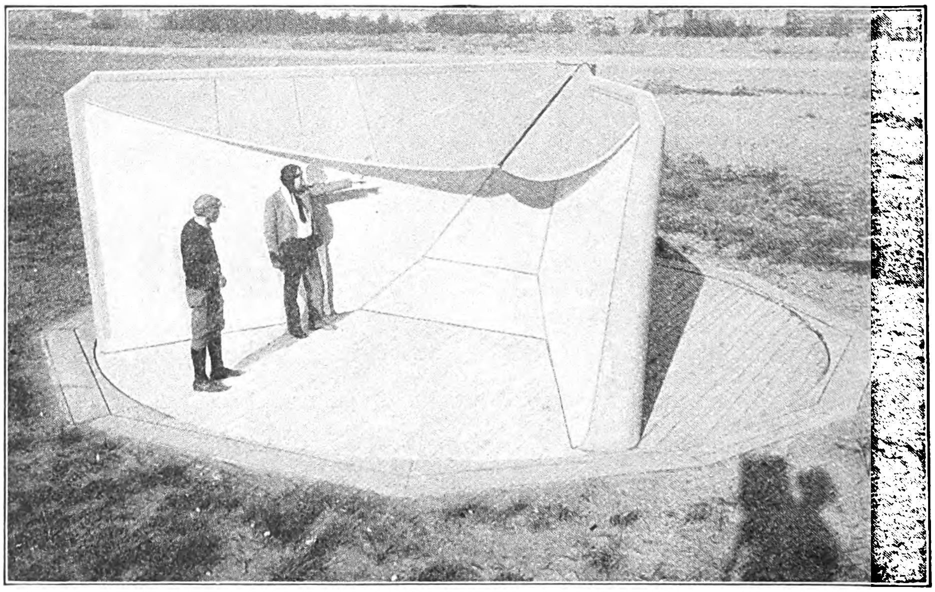
This view gives an excellent idea of the operation of the air-mail pick-up system described below. Notice the cable suspended from the plane, the released thimble, and the package thrown forward from the trap by the catapult

Air-Mail Pick Up and Release

The First Detailed Description of a Device Which May Become a Vital Factor in Speeding Up Aerial Transportation

EVER since the early days of the air mail and aerial transportation of freight and express, one of the drawbacks to increased speed has been the necessity of landing every time the plane has something to deliver or pick up. Such landings make it necessary to lengthen schedules far beyond the actual flying time between terminals and therefore tend to reduce one of the greatest advantages of aerial transportation—time saving. Consequently, the attention of inventors has been drawn to devices which will permit loading and unloading the plane while in flight. One of these, invented by Dr. Lytle S. Adams, of Seattle, Washington, was mentioned in our "Learning to Use Our Wings" department in the November, 1928, issue, and the details of it have just been made available.

A CAREFUL study of the illustrations on these two pages and of the following description will make plain the operation of this clever system. The equipment on the airplane includes a long, thin cable wound on a suitable drum and provided with a ball of special construction on the free end. On the ground is a peculiarly shaped structure such as illustrated on this page. Reference to these photographs will show that the top of this structure or trap slopes toward the center, where there is a long slot. See also Figures 1 and 2. When the cable with the ball on the end is lowered from the plane, the pilot maneuvers so that the ball, assisted by the curved sides of the trap, enters the slot. The ball then travels to the end of the slot where a slotted thimble has been fitted, and in which is a hole so small that the ball cannot pass through. Attached to this thimble, (see Figure 1) is the bag, sack, or other



THE SLOTTED BALL TRAP

This small demonstration model was mounted on a turntable in just the same way as will be the larger traps for regular air-mail use, the dimensions of which are given in Figure 6

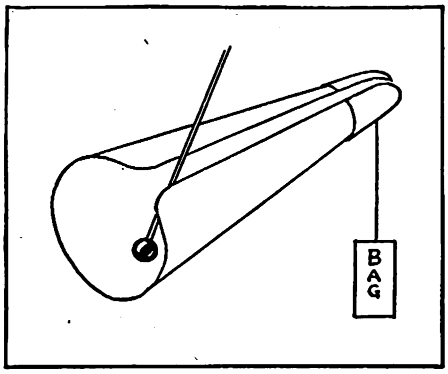


FIGURE 1

A simplified sketch, showing the slot, the ball, the thimble, and bag to be picked up

package to be picked up. The ball pulls the thimble from the end of the slot, a catapult (see Figure 4) throws the bag forward at a predetermined speed, and the plane flies on with its load. The cable is then wound up on the power-operated drum and the bag brought into the plane through a trap door.

Of course, all precautions are taken to prevent accidents. A friction clutch on the drum allows slippage in case of a slight entanglement, and the cable is of such size that it will break if too great a load is imposed upon it.

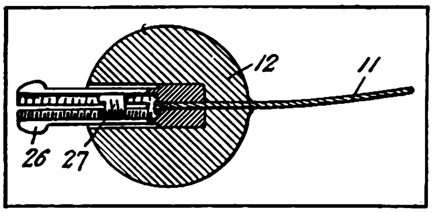


FIGURE 3

A cross-section of the ball, showing at 26 the removable section under spring-tension

With this system, it is possible to deliver and pick up at the same time. The ball (see Figure 3) is provided with a removable section 26 held in place by spring friction. To this is attached a thimble and to the thimble is fastened the package to be delivered. The pilot maneuvers as described and the ball and package enters the trap. At the end of the slot, the restriction is too great for the thimble to pass through, so the rear portion of the ball is pulled out, leaving the delivered package. The rest of the ball goes on and picks up the other thimble and the waiting package. This is shown plainly in *C* Figure 4.

In Figure 5 are given the details of the catapult, which can be adjusted to handle packages weighing from 50 to 200 pounds. The package is thrown forward automatically as the ball on the cable picks up the thimble. This places less strain on the cable. In Figure 6 is a simplified diagram of the entire ground part of the system, together with the main dimensions.

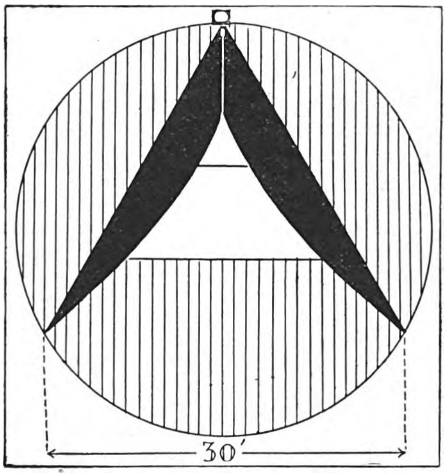
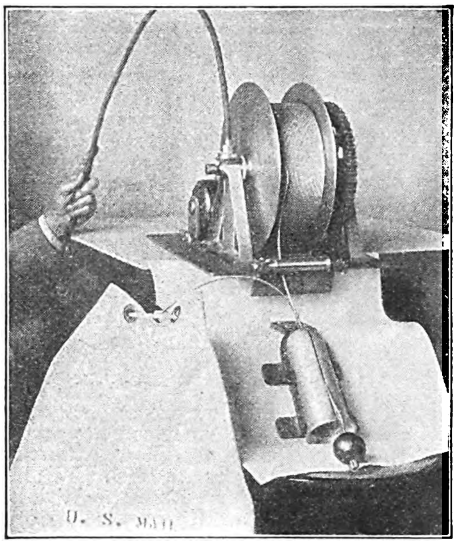


FIGURE 2

Top view of the ball trap. The turntable, the slot, and the curved edges are shown



CABLE REEL

In foreground are the thimble and the ball. A mail bag is shown fastened to the thimble

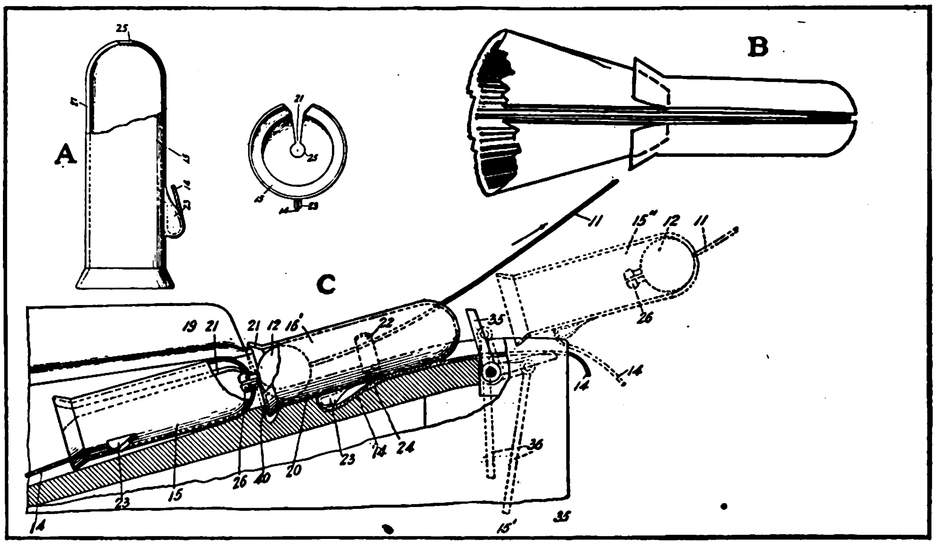


FIGURE 4

At *A* are shown two views of the thimbles. At *B* is a close-up view of one of them in position. At *C* is shown how the delivery and pick up methods work consecutively

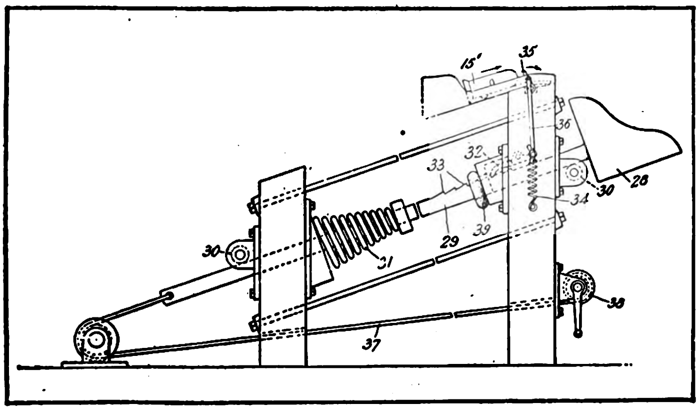


FIGURE 5

The catapult used in connection with picking up packages. As the thimble is released, a trigger is tripped and the catapult operates

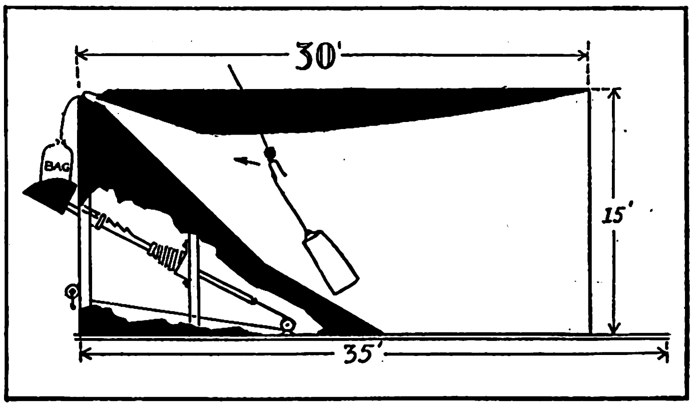


FIGURE 6

A cross-section of a ball trap, showing in simplified form the location of the various parts of the aerial delivery and pick up system

Pioneers of the Air

ORVILLE WRIGHT

GLENN H. CURTISS

UNTIL the end of time every plane that flies will be a winged tribute to the name of Wright. When Wilbur and Orville, brothers, wheeled their flying machine out upon the sands at Kitty Hawk, North Carolina, and with Orville sitting on the lower wing of the biplane, the craft soared into the air, they opened a new era—the era of man's domination of the air.

In the 25 years since then, we have gone far. From the experiments of the two proprietors of the little bicycle shop in Dayton, Ohio, has grown a mighty industry rich in romance, rich in scientific accomplishment, and freighted with tremendous possibilities for commercial expansion. In the development, the Wrights—at first the two of them, and later, when Wilbur died, Orville alone—have played a dominant role. Today a great organization—The Wright Aeronautical Corporation—manufacturing motors for airplanes bears their name, and Orville Wright's influence is felt throughout the flying world.

Of all living men, Glenn H. Curtiss, alone, is second to Orville Wright in his work in developing the science and industry of aviation. He it was who designed the motor for the first dirigible accepted by the American government; he directed the experiments of the famous Aerial Experiment Association at Hammondsport, New York, where he made the first pre-announced flight in the United States, winning the SCIENTIFIC AMERICAN trophy in 1908. With the many types of aeronautical motors he designed and developed, the whole world is familiar. Like the Wrights, his name is borne by a great manufacturing organization, The Curtiss Aeroplane and Motor Corporation, of which he is chairman of the Board of Trustees.

Builders of the Aviation Industry

Back of the Flyers Are the Men Who Are Making of Aeronautics a Giant Industry

By MILTON WRIGHT

DRAMATIC and tremendous impetus was given to aviation by the World War. We shuddered at news of the raids made by the Zeppelins and we were thrilled at the exploits of the Lafayette Escadrille, of Thaw and Rickenbacker and others.

With the end of the War, the development of aviation continued. Alcock and Brown flew across the Atlantic. With increasing frequency, one splendid adventurer after another claimed the attention of the public. Navy planes circled the globe; Byrd crossed the North Pole; and Lindbergh hopped from New York to Paris.

Behind the exploits of these heroes of the air, however, are men who make spectacular achievements possible—men who are so developing the industry and business of aviation that our times will go down in history as the age of man's complete conquest of the air. To learn a little about some of these dominant figures will be well worth while.

A. H. G. Fokker

ANTHONY Herman Gerard Fokker was born in 1890 of Dutch parents on the island of Java. When the boy was six, the father retired with his family to Haarlem, Holland, where the future aircraft designer grew up. As a child, Anthony followed the early experiments of the Wright Brothers and the French inventors, and constructed perfect model planes.

In 1911, he made his first real airplane, almost entirely with his own hands, and taught himself to fly. With this plane he won the Russian Military Competition at St. Petersburg in 1912. This and other demonstrations brought him a number of orders, and in spite of technical and financial difficulties, he began the manufacture of airplanes.

In 1912, one of Fokker's planes made a remarkable flight from Berlin to the Hague. The German Government became interested in him but his own government gave him no encouragement. The English Government likewise turned him down. Then the German Government made a three-year contract with him for the instruction of military pupils and a school was established at Schwerin.

The World War came and the business developed enormously. As the exploits of the German flyers grew in number and audacity, the fame of Fokker grew. In this period he invented a synchronizing gear, making it possible to shoot a machine gun between revolving propeller blades; he manufactured 42,000 of these for the German armies.

A. H. G. FOKKER

With the Armistice, Fokker moved to Holland and established at Amsterdam the Netherlands Aircraft Manufacturing Company. This company has made and sold more than 10,000 planes, produced 53 different types and made customers of governmental and commercial organizations in 25 countries.

Believing the greatest possibilities of commercial development to lie in America, Fokker, co-operating with a group of American business men, formed the Atlantic Aircraft Corporation at Teterboro Airport, Hasbrouck Heights, New Jersey, in December, 1923. Three years later the Fokker Aircraft Corporation was formed, absorbing the Atlantic corporation and establishing a new factory at Glendale, West Virginia. Late last year affiliations were made with a number of important air transport operators.

Sherman Mills Fairchild

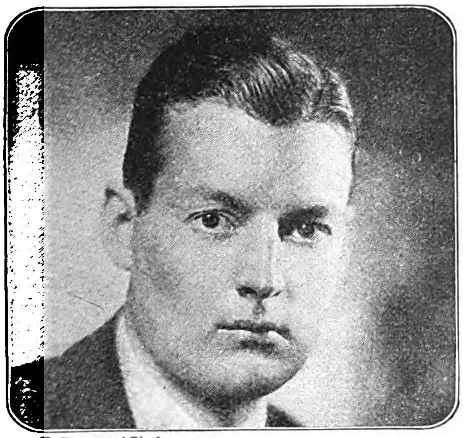
SURVEYING, map-making, and photography from the air are no small part of the benefits of aviation. The man responsible for their development is Sherman Mills Fairchild.

Fairchild is an engineer. After his graduation first from the University of Arizona and later from the Columbia University School of Engineering, he did considerable experimenting with aerial photography, eventually producing a camera which had several new features. The large camera manufacturers, however, were unable to solve satisfactorily the problem of making the roll of film feed the same amount for each picture. It was an important matter for the United States Government, and Fairchild received a telegram from Washington asking him to go to Rochester and spend a day in the factory studying the problem. He went.

On the train that night he invented a mechanism which eliminated all the difficulty. As soon afterwards as drawings could be made incorporating his idea, they were sent to Rochester, and the manufacture of his device was started. The bit of concentration on a railway train was the first of a series of steps which has led directly to the adoption by the American Government, the Canadian Government, and the Government of Brazil, of the Fairchild Aerial Camera.

For aerial camera work it is necessary that the airplanes used be sturdy, powerful, and reliable at all altitudes and all temperatures. To meet these needs, the Fairchild cabin plane was designed. When it appeared there arose a general demand for it and the Fairchild Airplane Manufacturing Company was formed in 1926. Its production has increased steadily as its reputation has spread, and the organization has developed rapidly.

A hint of the extent of the Fairchild activities may be gleaned from the names of the companies now grouped together. They include the Fairchild Aerial Camera Corporation; Fairchild Aerial Surveys, Inc.; Fairchild Caminez Engine Corporation; Fairchild Airplane Manufacturing Corporation; Fairchild Aviation Limited, Canada; Fairchild Air Transport Limited, Canada; Compania Mexicana de Aviacion, Mexico; and, dominating them all, the Fairchild Aviation Corporation.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SHERMAN MILLS FAIRCHILD

Harry F. Guggenheim

When Daniel F. Guggenheim established the Fund for the Promotion of Aeronautics in January, 1926, his son, Harry F. Guggenheim, became its president and a trustee of the Fund.

By training as well as by inheritance he is eminently fitted for the task. Schooled at Yale and at Cambridge, England, and trained in mining and metallurgy, he had been active in the development and management of mining properties as a member of the firm of Guggenheim Brothers. In the World War he served as a naval aviator in the Foreign Service of the American air forces in France, England, and Italy. With his relief from duty on December 21, 1918, commissioned as a lieutenant commander, his interest in aviation was definitely assured.

Under Mr. Guggenheim's direction, the Fund has divided its work into four categories: (1) academic instruction, (2) scientific research, (3) commercial development, and (4) public education. The first two objectives are represented in the Fund's gifts of more than 1,200,000 dollars to five large engineering universities to establish aeronautical laboratories.

HARRY F. GUGGENHEIM

To stimulate passenger carrying by air, the Fund has granted a loan to an air transport company to establish the first adequate passenger service in the United States. Over the route of this company, between Los Angeles and San Francisco, the Fund has helped to finance a complete weather reporting service.

Last May the Fund announced that it would concentrate its future efforts upon research and experimental work of a basic nature. In following out this policy, a full-flight laboratory has been established under the direction of Lieutenant James H. Doolittle, where the actual operation of aircraft in fog with the use of the many devices perfected for fog flying is part of the research. Another step was the inauguration of the Safe Aircraft Competition, offering prizes totaling 150,000 dollars for the airplane which should represent, in accordance with specifications laid down, the greatest advance in safety without sacrificing efficiency. The Fund also is financing the development of safety devices and navigation instruments by grants to societies and institutions engaged in such experimentation and has undertaken a nation-wide campaign for the identification of towns and cities.

Harris and Ewing

IGOR I. SIKORSKY

Igor I. Sikorsky

Five years after the Wright brothers flew their plane at Kitty Hawk, a 19-year-old Russian, Igor I. Sikorsky, began a distinguished career by building a helicopter at Kieff. Within the next two years he had built three airplanes and by 1911 he reached an altitude of 1500 feet and remained aloft for an hour. The next year he took the highest award at the Moscow Aviation Exhibition and won a prize at the St. Petersburg Military Competition against the leading manufacturers of Europe.

The following year Sikorsky constructed the first successful multi-motored airplane. In more than 50 flights he proved conclusively the soundness of the multi-motored principle. Aviation developed rapidly, but not too rapidly for Sikorsky to keep pace.

Russia used 73 giant Sikorsky airplanes in the World War. All but one returned victorious. It is said that in many respects these machines were more succesful than the machines of any other country.

With the outbreak of the Russian Revolution, Sikorsky entered the service of France. With the signing of the Armistice, he came to the United States and became an American citizen.

The Sikorsky reputation was such that in 1923 it was possible to form the Sikorsky Aero Engineering Corporation. In 1925 the business of this company was acquired by the Sikorsky Manufacturing Corporation, of which the inventor was president. Several highly successful types of airplanes were evolved, and the corporation moved to a larger plant at College Point, Long Island.

Recently the business has been reorganized as the Sikorsky Aviation Corporation for operation on a greater scale than ever before, in conjunction with the Curtiss Flying Service, Inc., and the Curtiss Export Association, which will direct its sales.

DR. KARL ARNSTEIN

Dr. Karl Arnstein

THE relative merits of heavier-than-air craft and lighter-than-air craft may be subject to spirited controversy, but of the fact that a man who dominates the lighter-than-air industry in this country belongs in any group of aviation's leaders there can be no dispute. Such a man is Dr. Karl Arnstein, vice president and chief engineer of the Goodyear Zeppelin Corporation, of Akron, Ohio, subsidiary of the Goodyear Tire and Rubber Company.

Dr. Arnstein was born in Prague, Bohemia, 42 years ago, He graduated from the university of his native city, serving in the faculty as assistant professor before he received his degree of doctor of technical sciences. It was not long before the young engineer was enjoying a wide reputation for his technique in stress analysis, and he was invited to join the growing organization of airship engineers on Lake Bodensee.

In 1914, Dr. Arnstein became chief engineer of the Zeppelin company, devoting his energies principally to the development of fundamental principles in airship design, with especial reference to the stress analysis of rigid airships and metal airplanes. He is responsible for the principal design of about 90 military and commercial airships, including the *Los Angeles*.

When Dr. Arnstein joined Goodyear he at once began the task of designing two military rigid airships of about 6,500,000 cubic feet capacity for the navy. The Navy's Bureau of Aeronautics had inaugurated two competitions and Arnstein set out to win them. He succeeded.

In October 1928, Goodyear was awarded the contract for two ships of this type and Dr. Arnstein has started to direct their construction as well as the erection of a giant airship hangar.

Charles L. Lawrance

AN outstanding development in flying today is the famous Wright Whirlwind motor. The man responsible for it is Charles Lanier Lawrance, pioneer in the development of air-cooled motors for airplanes and president of the Wright Aeronautical Corporation.

Lawrance's interest in motors began in the nineties when he was a student at Groton, although he actually began to tinker with combustion engines only after he entered Yale in 1901.

The young engineer had that rare combination: independent means and a liking for hard work. He went to Paris and for three years studied aerodynamics at the *Ecole des Beaux Arts*. In 1912 he developed an airplane wing section which, when tested at the Eiffel Laboratory, showed remarkable results. Returning to the United States in 1914, he began his first work on an air-cooled motor and organized the Lawrance Aero Engine Company with a working capital of only 17,000 dollars.

Marceau

CHARLES L. LAWRANCE

The army would have none of Lawrance's motors, but the navy ordered 450 of them for their grass-cutter type of training plane. Then he received an order for air-cooled engines for planes to be carried by submarines. America entered the World War and he was ordered to continue his laboratory researches. His first 200-horsepower engine resulted. It was radial, air-cooled, and much like the present Wright Whirlwind.

In 1923 the navy decided to buy no more water-cooled motors. The Wright corporation, deprived of an important market, found itself faced with the necessity of competing with Lawrance or buying him out. They paid him 500,000 dollars for his designs and patents and induced him to join their organization. The next year he was its president.

Clement Melville Keys

IT was all very well in the early days of aviation for the industry to grow through the efforts of men who were flyers, inventors, engineers, and air enthusiasts, but there came a time when the airplane business required men who were, above everything else, good business men. That time seemed to have arrived in 1916, when the Curtiss Aeroplane and Motor Corporation secured Clement Melville Keys as its vice president.

Keys was then 40 years old. Born in Canada, he had graduated from Toronto University in 1897 with a B. A. degree. He was destined for a career in finance and while still in his thirties became recognized as an investment authority.

A year after he joined the Curtiss organization, Keys added to his titles that of treasurer of the Curtiss Engineering Corporation. In two more years he was a member of the American Aviation Mission and chairman of the Finance Committee of the Curtiss Aeroplane and Motor Corporation. In 1923 he was made president of the corporation, a position he still occupies.

In aviation, as in many other fields, the interests of one kind of company overlap the interests of another, and Keys had broadened his activities to include related activities. He is president of the Trans-Continental Air Transport, the air-rail route between New York and the Pacific Coast. He also is chairman of the Executive Committee of the National Air Transport; senior partner of C. M. Keys and Company, investment brokers; chairman of the board of directors of the Curtiss Export Corporation and the Curtiss Flying Service; president of Glenn H. Curtiss Properties, Inc.; vice-president of Curtiss-Robertson Airplane Manufacturing Company;

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CLEMENT MELVILLE KEYS

and a director in the National Aviation Corporation.

William B. Stout

WILLIAM Bushnell Stout, journalist, teacher, mechanical engineer, and inventor, graduated from the University of Minnesota in 1902. After four years of writing for newspapers, he toured Europe in 1908 in an automobile and when he came back he began to specialize in automotive work. He became chief engineer of the Schurmeier Motor Truck Company, and technical and aviation editor of the *Chicago Daily Tribune*. In 1917 he became chief engineer of the aircraft division of the Packard Motor Car Company and later was appointed technical adviser to the Aircraft Board in Washington.

A few years ago he raised money for an aviation development on one of the most unusual pleas ever advanced by a promoter. He went to a number of leading business men in Detroit and said to each of them in substance: "I want to take 1000 dollars of your money to see if I can develop something in the aviation field. It is a sporting venture. You may never get a cent of it back, but I guarantee you 1000 dollars worth of fun."

Henry Ford became interested in Stout in 1925 and the next year aided him in establishing an air route between Detroit and Grand Rapids, using seven-passenger planes. It was an experimental line, and with the knowledge gained, the Stout Air Service opened another line between Detroit and Cleveland. In two and a half years, 65,000 passengers have been carried. The Ford and Stout interests have recently entered upon an extensive transport program beginning with air service between Detroit and Chicago.

Courtesy *Aero Digest*

WILLIAM B. STOUT

William E. Boeing

WHEN the National City Company of New York, and the Pacific National Company of Seattle, announced through the newspapers last October that they had invested from five to ten million dollars in the Boeing Airplane and Transport Company, investors in the east began to sit up and take notice. The merger was the herald of a nation-wide transcontinental air service between New York and San Francisco, using trimotored Boeing planes.

William Edward Boeing, dominant power in the organization which bears his name, was born in Detroit 47 years ago and graduated from Yale University. His flying instruction he received under Glenn L. Martin. After entering the navy, he became a lieutenant in the United States Naval Reserve Force.

Primarily, however, Boeing's interests have been those of a lumberman; for years he has been prominent in industrial and civic affairs in the northwest.

Aviation, with Boeing, is a hobby which began in 1915. That year he purchased a plane in San Francisco, and flew to Seattle with Commander Westerveldt of the United States Navy. His interest awakened, it was not long before he was re-designing a plane in accordance with his own ideas. He made two planes in his private workshop, and the tinkering grew into a manufacturing business. Today the Boeing factory has the largest payroll of any manufacturing company in Seattle, and, with approximately a thousand employees, is one of the largest airplane producers in the country.

Courtesy *Aero Digest*

WILLIAM E. BOEING

In 1926, Boeing took up a private contract with the Post Office Department to carry the mails for 1000 miles of the western-most leg of the transcontinental air mail. He has since added to his operations air mail and passenger service between Chicago and San Francisco and, through his subsidiary, the Pacific Air Transport, the air mail between Seattle and Los Angeles.

Richard F. Hoyt

RICHARD FARNSWORTH HOYT, A. B., Harvard, 1910, stands out as a man who is putting the aviation industry in the category of big business. His career in aeronautics began in the World War, when he was first civilian assistant to Colonel Vincent at McCook Field. Later he was secretary and assistant to the president of the Wright-Martin Aircraft Corporation. Today as chairman of the board of directors of the Wright Aeronautical Corporation, chairman of the Committee on Aeronautics of the Merchants Association of New York and member of the Advisory Committee of the Transportation and Communication Department of the Chamber of Commerce of the United States, he is a leading financial figure in aircraft affairs.

Marceau

RICHARD F. HOYT

Not long after his wartime service, Hoyt widened his interests and became chairman of the board of directors of the Wright Aeronautical Corporation.

Hoyt's activities have grown with public interest in air travel. He became chairman of the board of directors of the Aviation Corporation of Americas, which, through its subsidiary, the Pan-American Airways, now controls the world's largest system of international air routes. He also became chairman of the board of the Keystone Aircraft Corporation, builders of standard army bombing planes. Recently he was instrumental in effecting a merger between the Loening Aeronautical Engineering Corporation and the Keystone Corporation.

Brigadier General Benjamin D. Foulois

AS brilliant and distinguished a career as any soldier today possesses is that of Benajmin D. Foulois, the first army air pilot in point of service, self-taught in the first army airplane and now a brigadier general, assistant chief of the Air Corps.

While still under the legal age for enlistment, Foulois enlisted as a noncommissioned officer in the volunteer forces in the Spanish-American War. With the close of the war he enlisted in the regular army, and while serving in the Philippines was commissioned a lieutenant of infantry. His career was an adventurous one, and in 1908 he operated the first dirigible balloon purchased by the government. The following year he was selected as one of three army officers to operate the first military airplane purchased from the Wright brothers. He personally designed the first dirigible tent hangar. In the first cross-country trip made by a flying machine, during which three world records were broken, he was a passenger with Orville Wright. From January, 1910, to March, 1911, he was the only officer in the United States Army on flying duty. In this period, with repeated crashes, he taught himself to fly. The next year he adapted radio to airplane uses, receiving messages over a distance of 18 miles.

Official Photo, U. S. Army Air Corps

BRIG. GEN. B. D. FOULOIS

By 1915 the Aviation Section of the Signal Corps had grown to considerable size and Foulois, now a captain in command of the First Aero Squadron, operated his force in the co-ordination of artillery fire at Fort Sill, Oklahoma. The first serious consideration of the effectiveness of an air force was impressed upon military men when he moved his command by air 650 miles to San Antonio in five days. His work with the Mexican Punitive Expedition elicited from General Pershing the remark that one airplane was worth a regiment of cavalry to him.

In the World War, after planning the organization of the Air Force, he drafted the first appropriation for it, sailed to France as Chief of the A. E. F. Air Service, built the ground plans, and led the first all-American squadron of American planes and American pilots over the German lines. At the close of the war he served on numerous commissions, including the Supreme War Council.

Guiseppe M. Bellanca

AT a time when every aeronautical engineer was adjusting propellers on the rear ends of airplanes in order to make them push the planes ahead more effectively, one man had the temerity to put the propeller on the front end so that it could *pull* the craft through the air. Today the tractor plane, with the propeller on the bow instead of the stern, is almost universal.

That inventor was Guiseppe M. Bellanca, originator of radical innovations in airplane construction. One day in 1911, when he appeared at the flying field in Mineola with a single-seated parasol monoplane of unusual design and announced he was going to learn to fly it, the experts gave him three days to live. They would have made it three hours only the inventor said he was going to learn gradually by easy stages. Not only did Bellanca not come to grief, but it was not long before he opened the Bellanca Airplane School and taught other flyers, acting himself as a flying instructor from 1912 to 1916.

Bellanca was born at Sciacca, Italy, 43 years ago. He received his education at the Milan Technical School and the Royal Institute of Milan, becoming professor of mathematics in the latter institution in 1910. He had started in aviation in 1907 by writing for French and Italian technical magazines. In 1908 and 1909, with two friends he built a two-seater pusher biplane. It went a hundred feet and crashed, a circumstance which may or may not have had something to do with the fact that Bellanca has become the inventor of a large number of aircraft safety devices.

Bellanca's best known plane is the *Columbia*, which won the distance world's record with the flight of Chamberlin and Levine from New York to Germany. He also is designer of the *Roma*, the large ship built for the flight from New York to Rome and he now is constructing in the New Castle plant of the Bellanca Aircraft Corporation, of which he is president, a multi-engined plane which he believes is destined to play a leading role in the progress of aviation this year.

Courtesy *Aero Digest*

GUISEPPE M. BELLANCA

Charles H. Colvin

THAT the development of navigation of the air depends upon the development of instruments goes without saying. Here is the field in which reigns Charles H. Colvin, general manager of the Pioneer Instrument Company, surviving member of a triumvirate of air instrument makers.

CHARLES H. COLVIN

In 1913, a year before he received his M.E. degree from Stevens Institute of Technology, Colvin became associated with the Curtiss company. The next year he joined the Sperry Gyroscope Company as a designer of instruments. In 1919, with the late B. H. Goldsborough, he founded the Pioneer Instrument Company, opening a small workshop in New York.

While Goldsborough worked at the bench, Colvin started out to find enough business to keep his partner busy. His first sale was to the United States Government for turn indicators to be placed on the NC flying boats which attempted the navy's first transatlantic flights.

As the business grew the firm moved to larger quarters where they built gages and other instruments. In 1920 they were joined by the late M. M. Titterington and the three became the leading designers in the country. It was they who supplied instruments for the 'round-the-world flyers and for Lieutenant Russell L. Maughan, who made the first dawn-to-dusk transcontinental flight.

The earth inductor compass, employing radically new principles of design, they introduced in 1927. It was this instrument which so materially aided Lindbergh in his flight across the Atlantic that he hit the mark at which he aimed within less than five miles. Following Lindbergh, every trans-oceanic aviator has equipped his plane with the same type of instrument.

Grover C. Loening

THE first degree ever awarded by an educational institution for aeronautical research was given to

Grover C. Loening when he received his master of arts degree at Columbia University. Today, Loening, born in the American Consulate at Bremen, Germany, where his father was United States Consul, is one of the world's leading airplane designers.

In 1911 and 1912, Loening was chief engineer of the Queen Aeroplane Company of New York and the next two years general manager of the Wright company at Dayton. With war in Europe, army authorities in this country began actively to enlarge their aircraft facilities and in 1914 and 1915 Loening occupied the post of chief aeronautical engineer for the United States Army Air Corps.

In 1916 he turned again to manufacturing, being vice president and general manager of the Sturtevant Aeroplane Company of Boston for two years. Then he organized his own company, the Loening Aeronautical Engineering Corporation, recently merged with the Keystone Aircraft Corporation. He also was president in 1923 of the New York-Newport Air Service, Inc.

Loening's achievements in aviation have been of a varied nature. Back in 1911, he built and flew the first flying boat. He also originated the monoplane flying boat, and, at the Wright plant in 1912, the first American short-hull flying boat. In 1914, at San Diego, he invented the first rigid-braced pursuit monoplane and the following year at the same place he built the Signal Corps tractor used by Lieutenant B. I. Jones in establishing the world's three-passenger endurance record and by Lieutenant T. F. Dodd in making the cross-country record.

© Bruno and Blythe
GROVER C. LOENING

In 1916, he introduced steel construction in the Sturtevant biplane and in 1917 he began the design and development of the Loening monoplane and the Loening seaplane. In fact, he still is continuing the development of new and original designs for the government.

The Collier Trophy for 1922 was won by Loening for his design and development of the Loening "Air-Yacht." The previous year he had won the Wright Trophy. In 1923 he designed the world's first single-motor tractor amphibian.

SYLVANUS ALBERT REED

Sylvanus Albert Reed

YOU can count on the fingers of one hand the men over 50 years of age who are accomplishing things in aviation, but there is one man born in 1854—Sylvanus Albert Reed—who is making his mark. His contribution to the industry is the famous Reed metal propeller, with which many outstanding military, naval, and commercial records have been made.

After a career as a mining engineer, Reed retired in 1912 to occupy himself in experimental research in his private laboratory. Engaged in problems of sound, he used apparatus in which vanes rotating from a hub were spun at high speed. He thought he saw an application to aircraft propellers and entered upon a three years' job of experimental research with models, producing in 1921 his first duralumin propeller. It proved successful in public test flights and he then made at his own expense about 50 more for a variety of duties, several being sent abroad for government tests.

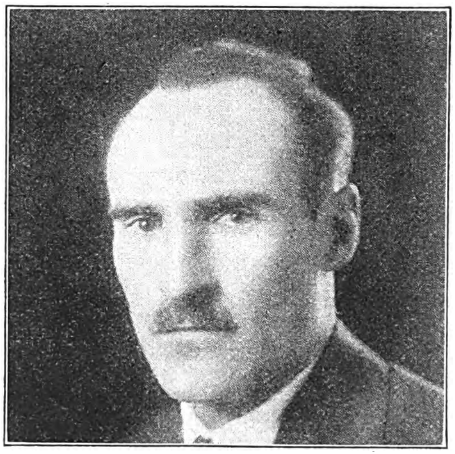
Attracted by his results, the Curtiss company in 1923 entered into a license agreement with him to make and sell his propellers, upon which he had applied for patents in 1920 and 1921. These propellers were used in the planes the Curtiss company was making for the army and navy races in 1923 and for the Schneider and the Pulitzer cup races. Their performance attracted the attention of aircraft people generally. Regular production of the Curtiss-Reed propellers followed and in the next three years most of the new army, navy, and air-mail planes were using them. In 1926, the Collier Trophy was awarded to Reed for his propeller as the most important achievement in aeronautics for the previous year. He now is occupied with experiments to increase the efficiency of 87 percent with which his racing propellers are believed to have operated, as well as to develop special types of propellers for new conditions which may arise.

Charles Sherman Jones

PERHAPS the best known commercial pilot in the country is "Casey" Jones, holder of Transport License Number 13 of the Department of Commerce. He happens to be president of the Curtiss Flying Service, a member of the Technical Committee of the National Air Transport and a director of the Curtiss Aeroplane and Motor Company and of the Curtiss Export Company, but there is a certain "human-ness" about him that tends to make him a familiar person.

Long before Charles Sherman Jones, a Vermont Yankee, graduated from Middlebury College with an A.B. degree, he had been interested in aviation. He had made his first flight in 1911 when a high school classmate bought a machine. In June, 1917, he entered the Army Air Service and after a period of flying instruction in this country and in France, which ended with his being made an officer in charge of flying, he went to the front with the 96th Pursuit Squadron and then became assistant officer in charge of training with the Third Aviation Instruction Center, where all the pursuit training of American troops in France was given.

Back in America again, he joined the Curtiss organization and organized the Curtiss Exhibition Service, later known as the Curtiss Flying Service, and has become famous as a test pilot. He has competed in substantially all the national air races, starting in 1919 with the New York-Toronto race where he won second place. Since 1921, when he won the American Legion Derby, his string of trophies has lengthened steadily, including two firsts and a second in the 1921 National Air Races, two firsts in 1925, and a first and a second in 1926.


C. S. ("CASEY") JONES

What Things Are Made Of—II

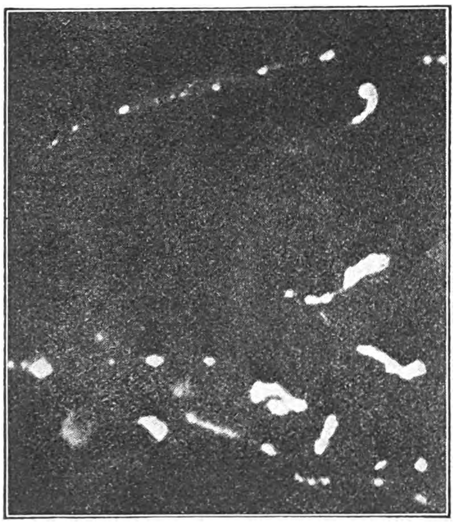
The Paradox of Light; Einstein and the Photoelectric Effect; Peculiar X-Ray Echoes; Photons and Electrons; The Paradox of Particles and Waves

By ARTHUR H. COMPTON, Ph.D.

Professor of Physics, University of Chicago.
Member American Philosophical Society; National Academy of Sciences;
National Research Council. Nobel Physics Prize Winner, 1927

(*Concluded from February*)

THE tangible things with which we are acquainted, rocks and mountains, trees and people, are built of atoms and electrons and protons. In stating the subject of this article, however, the word "things" was chosen because it included an important something which we are apt to overlook. I refer to light and similar radiations such as wireless waves and X rays which may be grouped with light under the term "radiations." What is light?



ELECTRON TRAILS

Figure 13: Beta particles recoiling from the impact of X-ray particles or "photons"

As long ago as the 17th Century, Newton defended the view that light consists of little particles shot with tremendous speed from a candle or the sun or any other source of light. At the dawn of the 19th Century, however, experiments were performed which gave very direct evidence that light consists of waves. Maxwell interpreted them as electromagnetic waves and in such terms we have ever since been explaining light rays, X rays and radio rays. We have measured the length of the waves, their frequency, and other characteristics and have felt that we know them intimately. Very recently, however, a group of electrical effects of light has been discovered for which the idea of light waves gives no explanation, but whose interpretation is obvious according to a modified form of Newton's old theory of light particles.

The evidence that these radiations consist of waves is so familiar that I shall not take time to outline it. Let me, rather, present some of the reasons why we feel that light consists of corpuscles.

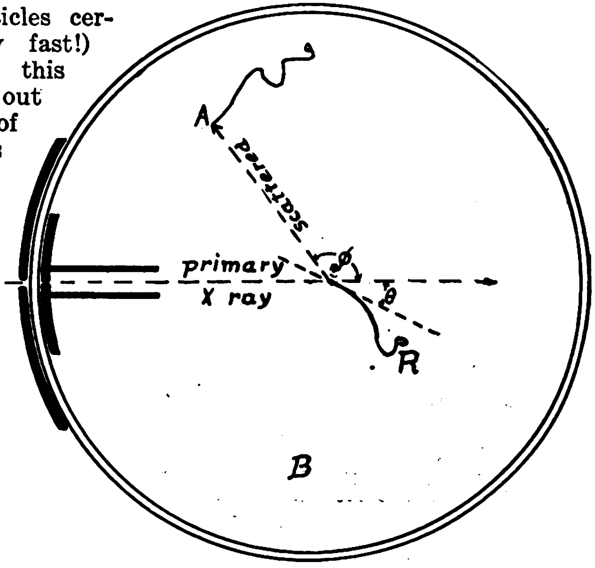
When a beam of light falls upon the surface of certain metals, such as metallic sodium, electricity in the form of electrons is found to be emitted from the surface. This effect is especially prominent with X rays, for these rays eject electrons from all sorts of substances, as was shown for example in Figure 7 (see February issue). X rays are produced when a stream of electrons hits a block of metal inside an X-ray tube. It is as if one were shooting at a steel plate with a rapid fire gun. The stream of bullets represents the electrons and the racket produced when the bullets strike the steel plate corresponds to the X rays emitted at the metal target inside the tube.

LET us suppose that an electron strikes the target of an X-ray tube at a speed of say 100,000 miles a second. (These little particles certainly move tremendously fast!) The X ray produced by this electron may be knocked out of the metal, and the speed of this electron will be almost as great as that of the original electron which gave the rise to the X ray.

The surprising nature of this phenomenon may be illustrated by an experience which I had when camping in my early boyhood. My older brother, with several of the older boys, built a diving pier around the point a half mile away from camp, where the water was deep, while we younger boys built a diving pier of our own in the shallower water near the camp. One hot, July day my brother dived from his diving board into the deep water. By the time the ripples from the splash had gone around the point to where I was swimming a half mile away, they were of course much too small to notice. You can imagine my surprise therefore when these insignificant ripples, striking me as I was swimming under our diving pier, suddenly lifted me bodily from the water and set me on the diving board!

Does this sound impossible? It is no more impossible than for an ether ripple sent out when an electron dives into the target of an X-ray tube, to jerk an electron out of a second piece of metal with a speed equal to that of the first electron.

CONSIDERATIONS of this type showed to Einstein the futility of trying to account for the photoelectric effect on the basis of waves. He suggested, however, that this effect might be explained if light or X rays moved in particles. These particles we now call "photons." The picture of the X-ray experiment on this view would be that when the cathode electron strikes the target of an X-ray tube, its energy of motion is trans-



TRAILING AN X RAY

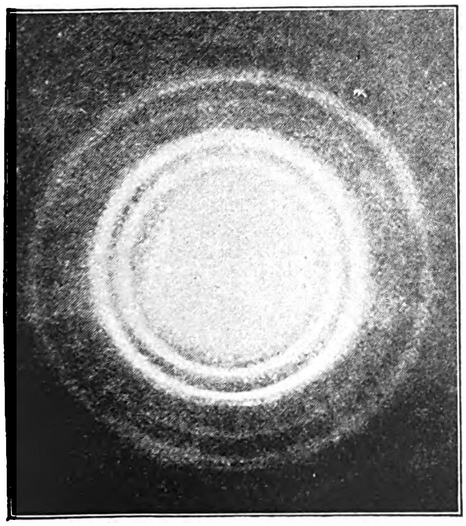
Figure 14: Photographing two electrons, *R* and *A*, struck by an X ray. See the text

formed into a photon, that is, a particle of X rays which goes with the speed of light to the second piece of metal. Here the photon gives up its energy to one of the electrons of which the metal is composed, and throws it out with an energy of motion equal to that of the first electron.

Thus Einstein was able to account in a very satisfactory way for the phenomenon of the emission of photoelectrons. But his theory had been devised for just this purpose. It was not surprising that it should work well for this one fact. It would naturally carry much greater weight if it could be shown that his theory accounted for other facts for which it had not been originally intended. This is what it has recently done in connection with certain properties of scattered X rays.

If you hold your hand in the light of a lamp, your hand scatters light from the lamp into your eyes. This is the way by which your hand is made visible. In the same way, if the lamp were an X-ray tube, your hand would scatter X rays to your eyes. If you had a blue light in the lamp, your hand would appear blue. If the light were yellow, your hand would appear yellow and so on. But some five years ago, we noticed that when one's hand or anything else scatters X rays, the "color" or wavelength of the rays is changed. The corresponding effect with light would be for one's hand to appear green when illuminated with a blue light, to appear yellow when illuminated with green light, red when lighted by a yellow lamp and so on. [This change in wavelength is now known to physicists as the "Compton Effect," after the author of the present article.—Editor.]

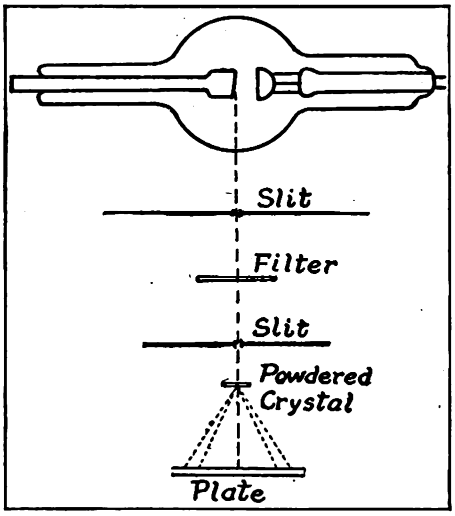
If X rays are waves, scattered X rays are like an echo. When one whistles in front of a barn, the echo comes back with the same pitch as the original tone. This must be so, because each wave of the sound is reflected from the barn, and as many waves return as strike, so the frequency or pitch of the echoed wave is the same as that of the original wave. Similarly an X-ray echo should be thrown back by the electrons in the scattering material, and should have the same pitch or frequency as the incident rays. Thus the wave theory does not account for the lowered pitch which the scattered X rays are found to have.



DIFFRACTION OF X RAYS

Figure 17: Pattern obtained by passing a pencil of X rays through powdered aluminum crystals (Hull). See Figure 18

The corpuscular idea revived by Einstein suggests, however, a simple explanation of this effect. On this view, we may suppose that each X-ray photon is deflected by a single electron, just as, for example, a golf ball might bounce from a football.



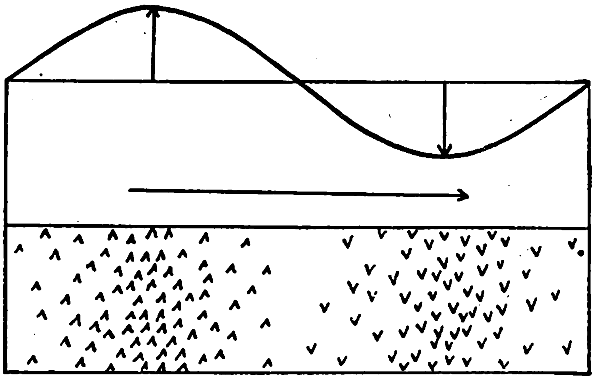
HULL'S APPARATUS

Figure 16: Used for performing X-ray diffraction experiments with crystals. Thomson uses an analogous apparatus

The football will recoil from the golf ball, and part of the energy is spent in setting the football in motion. Thus the golf ball bounces off having less energy than when it struck. In the same way, the electron from which the X-ray photon bounces will recoil, taking part of the photon's energy, and the deflected photon will have less energy than before it struck the electron. The reduction in energy of the X-ray photon corresponds on Einstein's view to a decrease in frequency of the scattered X rays, just as the experiments show. In fact, the theory is so definite that it is possible to calculate just how great a change in pitch should occur, and the calculation is found to correspond accurately with the experiments.

Within a few months after this new theory of the scattering of X rays had been proposed, Dr. C. T. R. Wilson was able to photograph the trails left when electrons in air recoiled from X rays which they scattered. In Figure 13 there are two high-speed beta particle trails at top and bottom. These are photo-electrons. Between them are shorter trails left by electrons recoiling from X rays which they have scattered. Notice how those which are knocked straight ahead go farther than those which received a glancing blow. Thus we have observed not only the loss in energy of the deflected golf balls, but also the footballs, or electrons, from which they have bounced.

Finally it was found possible to follow not only the electron which recoiled from the impact of the X ray, but also the path of the deflected X-ray particle as it bounced from the electron. Through the air in a cloud expansion chamber (Figure 2, February issue) was passed a beam of X rays so faint that we would find only one or two electrons recoiling from the scattered X rays, as in Figure 14.

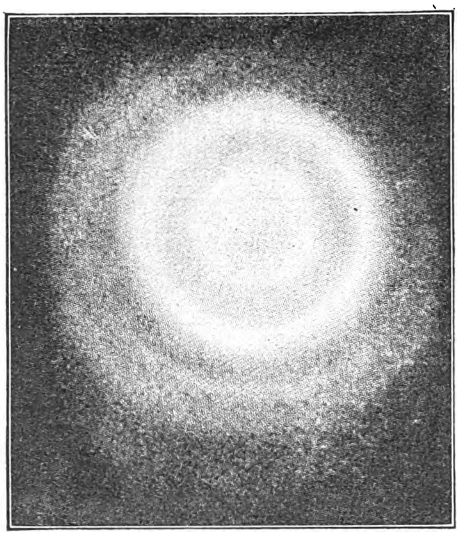


"PERHAPS THE BEST PICTURE"

Figure 15: Sheets of photons may make up electromagnetic waves. The wave is represented above; the sheets of photons corresponding to it are below

Now if the recoiling electron moves downward, the X-ray particle must have glanced upward, just as when the golf ball bounces to one side the football recoils to the other. If, however, the scattered X ray goes as a wave, spreading in all directions, there is no more reason to expect it to affect a second electron on one side that on the other. The photographs show that the second electron struck by the scattered X ray is on the side corresponding to A of Figure 14, opposite to the direction of recoil of the first electron. An X ray is thus scattered in a definite direction, as it should be if it is a particle.

But if X rays consist of particles, so also must light and heat rays, for they are all the same kind of thing. For centuries it has been thought that the corpuscular and wave conceptions of the nature of light are contradictory; but when we are confronted with apparently convincing evidence that light consists of particles, the two conceptions must in some way be reconcilable. The theoretical physicists are hard at work on a reconciliation of the two theories. One suggestion is



DIFFRACTION OF ELECTRONS
Figure 18: Diffraction pattern obtained by passing a pencil of electrons through powdered crystals of gold. See Figure 17

that the energy of radiation is carried by the particles and that the waves serve merely to guide the particles. According to the second view, the particles of radiation exist in any true sense only when the radiation is acting on atoms or electrons, and that between such events the radiation moves as waves. These ideas, however, are difficult to state in any satisfactory form.

Perhaps the best picture that one can give of the relation between waves and particles is the analogy of sheets of rain which one sometimes sees in a thunderstorm. We may liken the waves to the sheets of rain that one sees sweeping down the street or across the fields. The radiation particles or photons would correspond to the rain drops of which the sheet is composed. Such an idea is pictured in the diagram, Figure 15.

THIS conception is probably fairly accurate when we are thinking of radio rays. For in the case of radio rays, even a feeble signal, such as one broadcast from Los Angeles and heard in New York, would have waves consisting of thousands of photons per cubic inch. But in the case of X rays, a single photon carries enough energy to detect—and one particle is difficult to arrange in sheets.

The fact remains that the evidence before us seems to demand that light and other forms of radiations consist both of waves and of particles.

If then, light, which has long been known as waves is now found to consist of particles, may it not be that such things as atoms and electrons which have long been known as particles may have the characteristics of waves? Thus reasoned the French physicist de Broglie. He went so far as to calculate what the wavelength of an electron should be when moving at a certain speed. The calculation indicated that the wavelength of an electron moving at moderate speed is about the same as the wavelength of an X ray.

Now it is not many years since the wave characteristics of X rays were demonstrated by finding that they may be diffracted by crystals. De Broglie's suggestion was accordingly tested during the last year by two Americans, Davisson and Germer, by diffracting an electron stream from a crystal in the same way. They found in these experiments the same kind of interference effects that Laue and the Braggs had observed with X rays.

About a year ago I had the pleasure of calling on Sir J. J. Thomson, who did so much to establish the corpuscular nature of the electron. His son, G. P. Thomson, was home on a visit, and was telling his enthusiastic father and myself of his new experiments on the diffraction of electrons. This experiment was the analogue of Hull's powder method of diffracting X rays by crystals.

HULL'S apparatus may be illustrated by Figure 16. A beam of rays passes through a pair of slits and traverses a mass of powdered crystals which throw a diffraction pattern on the photographic plate. Using a beam of X rays of a definite wavelength traversing a mass of aluminum crystals, Hull obtained the photograph shown in Figure 17.

In Thomson's experiment, the X-ray tube was replaced by the cathode of a vacuum discharge tube. The electrons in the cathode ray stream were shot through a thin sheet of gold leaf (which replaces the powdered crystals in the X-ray experiment) and then fell on the photographic plate. Figure 18 shows the result. By the close similarity between Figures 17 and 18, Professor G. P. Thomson was able to convince his father, as well as the rest of us, that we now have precisely the same kind of evidence for believing in the wave characteristics of electrons that we have for believing in the wave characteristics of X rays.

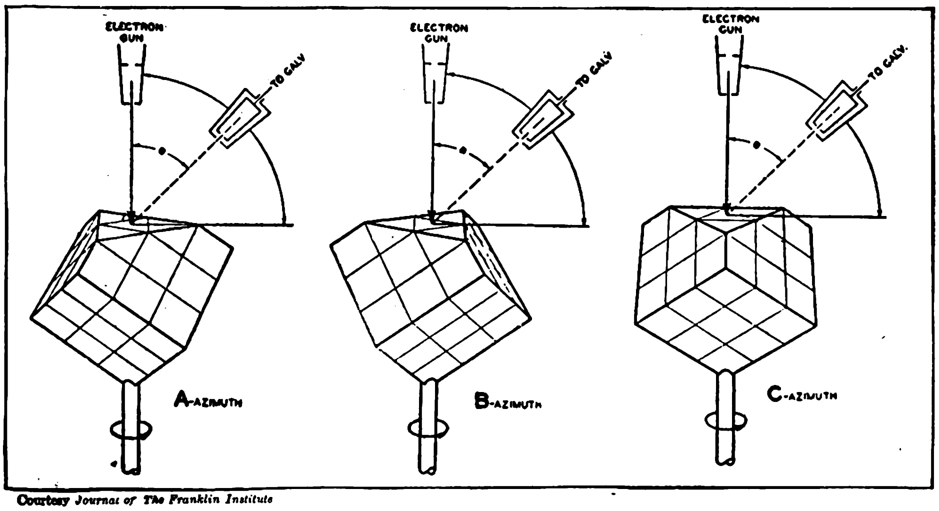
Our paradox of waves and particles is thus not confined to the nature of light, but applies to electrons as well. Atoms and molecules are now also being treated as complex bundles of waves. Light which we have long thought of as waves has the properties of particles; and electrons which Figures 7 and 8 show so clearly as particles have the properties of waves. There seems to be a dualistic aspect to these fundamental entities. The distinction between the conceptions of waves and particles may not be as sharp as we have thought.

HOW then does the matter stand? The tangible objects with which we are familiar we find constituted of molecules. These, in turn, are composed of atoms and these of positively charged and massive protons and the negatively charged and mobile electrons. The light which makes plants grow and which gives us warmth has the double characteristics of waves and particles, and is found to consist ultimately of photons.

Having carried the analysis of the universe as far as we are able, there thus remain the proton, the electron, and the photon—these three. And, one is tempted to add, the greatest of these is the photon, for it is the life of the atom.

We sometimes think of standardization as being the distinctive keynote of modern industry. But even a Ford car has hundreds of parts that differ from each other. What, then, shall we say of the Workman who by using only three different parts, protons, electrons, and photons, has made a universe with its infinite variety of beauty and life?

THE END



Courtesy *Journal of The Franklin Institute*

APPARATUS FOR INVESTIGATING ELECTRON DIFFRACTION

Electrons from a tungsten filament are accelerated by an electron gun; they strike a crystal of nickel and are received by an adjustable collector. The three positions permit measuring intensity of scattering of electrons not only at various angles but three azimuths, derived from the molecular structure of the crystal. An experiment performed by Davisson and Germer

OUR POINT OF VIEW

Aviation Strides Ahead

A QUARTER of a century ago—in 1903, to be exact—the Wright brothers, Wilbur and Orville, made the first successful flight in an airplane at Kitty Hawk, North Carolina. At the dedication of Wright Field, Dayton, Ohio, several months ago, Orville Wright watched many airplanes roar by in a terrific race. A direct question, put by someone nearby, seemed to carry his thoughts back to the days of the early experiments of his brother and himself, and he is said to have sighed and answered slowly: "No, neither of us thought it would ever come to this."

In its 25 years, aviation has made undreamed-of strides despite the fact that the first five of those years were required to convince the world that man *could* fly. After little more than another five years, a war showed the great military value of airplanes and, because of the extensive use of them under trying circumstances, gave a hint of their potentialities during peace time. Following that conflict, the field of their usefulness was greatly expanded: mail and passenger air lines were started; oceans were crossed; the arctic was explored and the North Pole reached by hardy aviators; and just the other day, five army men stayed aloft in a three-motored airplane for over 150 hours.

"Stride" would seem an inept term to use in connection with machines that fly, were it not that aviation is now in the big business class. An indication of what may be expected in the future is seen in the announcement recently of an air transport and manufacturing merger which has a capitalization of 150,000,000 dollars! Those who have kept abreast of the developments in this great industry can well understand, therefore, why we have devoted this issue largely to aviation.

Identify Your Town

POSTMASTER-GENERAL NEW has endorsed, and the Departments of War, the Navy, and of Commerce are co-operating in, the campaign for the identification of towns and cities by roof markings, recently begun in an intensive way by The Daniel Guggenheim Fund for the Promotion of Aeronautics. The Fund's first step in this movement was to enlist the aid of postmasters in towns of from 1000 to 50,000 population. This group of public servants provides a nucleus for the project but these men, in a great many cases, can do scarcely more than initiate the movement in a small way in their towns. The active work of more influential men and of organizations is necessary.

The job, for any given community, is not a big one—insofar as the actual work and expense are concerned; but, judging from the general apathy with which previous agitation for such identification markings has been received, it is Brobdingnagian. Smug little towns and lethargic big ones, all fail, apparently, to realize that aviation is well established, that it is now part and parcel of the nation's business and is rapidly becoming more so every day. Apparently, also, they neglect to take cognizance of the fact that the air mail is a strong link in the chain of progress yet must be strengthened further, if not for the sake of the important mail carried, then for the sake of the pilot whose life may be forfeit because he cannot get his bearings. The speed of the air mail helps make possible greater prosperity because it expedites the transactions of business and industry.

President Hoover

AN event, unique in the annals of the United States, takes place on the fourth of March: the first engineer to hold the office of chief executive of the nation will be inaugurated. Other presidents have had some engineering experience, but none has had such complete, worldwide, and successful engineering experience as Herbert Hoover.

Prophecy is cheap; it is easily dispensed, gladly accepted by those who *want* to believe it, and flatly contradicted by those who don't. Predictions of what will transpire during Mr. Hoover's administration, or even conjectures, are practically valueless and will be omitted here. Mr. Hoover takes the office with such a well-rounded knowledge of human, national, and international affairs, however, that it is believed that the United States will assume a higher place as a world power under his leadership.

Recently, an asteroid, or miniature planet, discovered by Professor Johann Palisan of Austria, was named "Hooveria" by a unanimous vote of the senate of Vienna University, in honor of the man who fed starving, war-worn Europeans during the World War. The fact that our new president commands such respect and admiration abroad leads us to hope that our international relations will be greatly improved during his administration. What with misunderstandings concerning questions of policy, armaments, war debts, et cetera, they are, indeed, sadly in need of improvement.

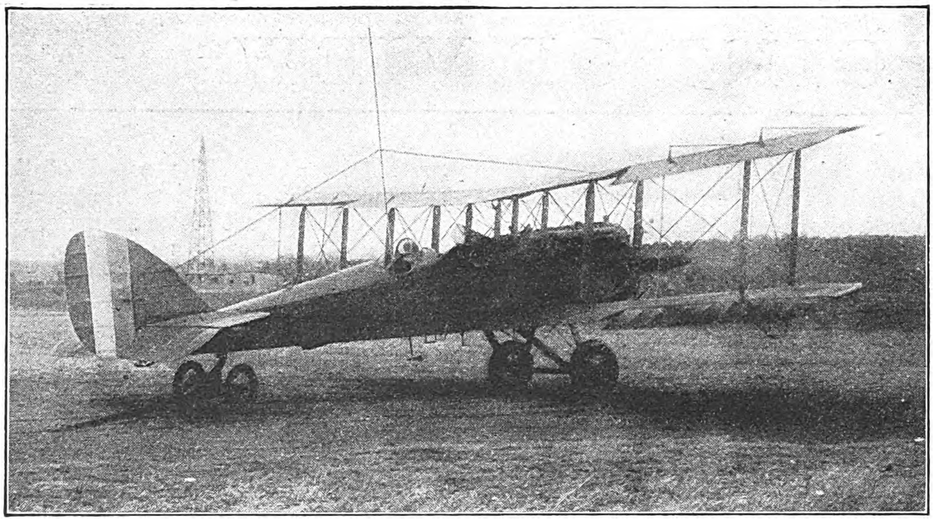
A few gallons of paint, a convenient roof top or two, of appreciable size, and the services of a painter for two or three days: that is all that is necessary to identify a town properly. And yet very few towns so far have shown that they are not of the smug or lethargic type, although some industries, notably oil corporations, have marked their roofs. What is hard to understand is that practically every sizeable city in the country has not already identified itself in this manner. It should be a matter of civic pride.

Bringing the Ultra Violet Indoors

NEXT month we expect to publish the interesting answers to our questionnaire on special window glass for transmitting the ultra-violet rays of the sun for health purposes. We have sent this questionnaire to a limited, selected list of specially qualified authorities—chiefly, noted physicists and physicians who specialize in ultra-violet radiation. The replies already received are gratifying. They show that these foremost authorities have put serious thought upon the question. Many have expanded their answers to considerable length elucidating their opinions and we dare anticipate that the ultra-violet transmitting glass questionnaire, when published, will attract widespread and long-continued attention.

The most interesting replies were provoked by the simple inquiry whether the public is justified in purchasing this special glass for homes, nurseries, schoolhouses, workshops, and offices, particularly in those cases where the ones who expect benefit cannot sit in the direct, transmitted sunbeams.

While mentioning ultra-violet transmitting glass we wish to make as clear as we possibly can one point which has apparently been widely misunderstood. In 1928 it was discovered that even the best of the glass loses some of its transmitting powers after a few weeks of exposure to the sun. After hearing of this unexpected phenomenon many appear to have concluded that this depreciation continues indefinitely, and that the glass finally loses all of its special advantage. This, however, is far from the case. There is unanimous opinion among physicists who have conducted tests that this depreciation comes to a virtually permanent stop after passing a certain part-way point.



A BEACON-EQUIPPED PLANE

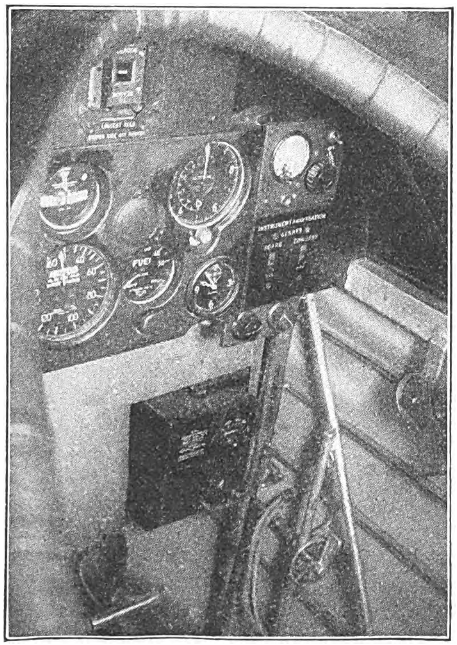
The ten-foot vertical rod is the antenna which serves to pick np the radio waves emanating from the radio-beacon transmitter. It replaces the old cumbersome, dangerous trailing wire

Radio Guides the Airway Traveler

Radio Beacons Provide Increased Safety In Fog and Storm

By ARMSTRONG PERRY

ON stepping into the pilot's seat of an up-to-date airplane, the pilot or student aviator faces an instrument board containing, among other instruments, a radio-beacon indicator. This device enables him to keep his ship on a course that is marked by aircraft radio beacons.



IN THE COCKPIT

Directly below the rim of the cowling is seen the reversible radio-beacon indicator

The airplane is equipped with a vertical rod antenna ten feet high. The trailing wire antenna, which more than any other has been used on airplanes in the past, is dangerous and is not suitable for use with radio-beacon receivers. Therefore, the pilot no longer has to remember to unreel a long wire and reel it in again before landing, and he does not have to worry for fear that the "lead fish," used to hold the trailing wire steady in the air, will fall off and harm someone on the ground.

THE United States Government has lighted 11,000 miles of airways for night flying and is providing powerful searchlight beacons for other routes as fast as possible, but clouds, fog, and storms often prevent air pilots from seeing these lights.

Radio beacons are necessary in order that airplanes may depart and arrive on time and maintain dependable service. They have been developed by the United States Bureau of Standards and are being installed on the principal airways by the Department of Commerce. The radio-beacon indicator on the instrument board enables the pilot to keep on the course marked by one of these beacons, whether or not he can see beyond the nose of his plane.

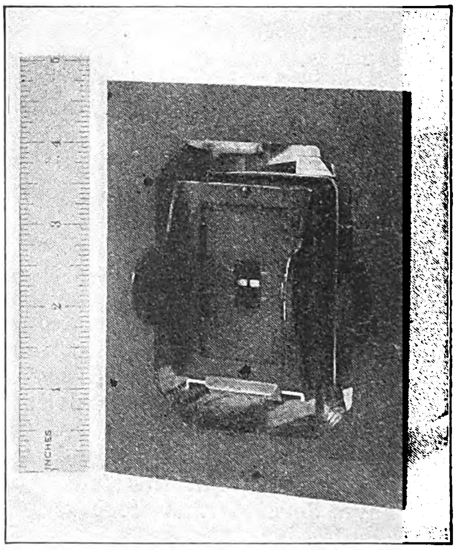
The indicator is connected with a small radio receiver which is installed in the tail of the airplane or in some other place where it is out of the way. This receiver is tuned to the wavelength of the radio-beacon transmitter before the airplane leaves the ground. The transmitter is located just outside the landing field.

As soon as the airplane is in the air and headed in the general direction that it is supposed to take, the pilot starts the radio-beacon indicator by pressing a button or throwing a switch. Two slender metal reeds with white tips, that have been motionless on the face of the indicator, begin to vibrate.

THE white tips move so rapidly that the eye scarcely can see their motion, and they form white lines that are easily seen against their black background. There is enough black space between the two lines so that each can be seen separately and distinctly.

So long as the two white lines are of equal length, the airship is on her course. If the line at the right grows longer, that shows that the ship is getting off her course and is to the right of it. If the line at the left grows longer than the one at the right, that shows that the ship is to the left of her course.

This radio-beacon indicator will guide the pilot unerringly along his route so long as he stays on the course and keeps the two white lines of equal length. The course marked by the radio beacon transmitter is only from 3½ to 5 degrees wide. If the pilot flies out of this area, as he may do in order to avoid a storm, he will, of course, know whether he flies to the left or to the right of it and will watch his compass and know the general direction of flight. When he wishes to return to the course, he steers in the general direction of it and keeps on until the white lines on the indicator



THE INDICATOR

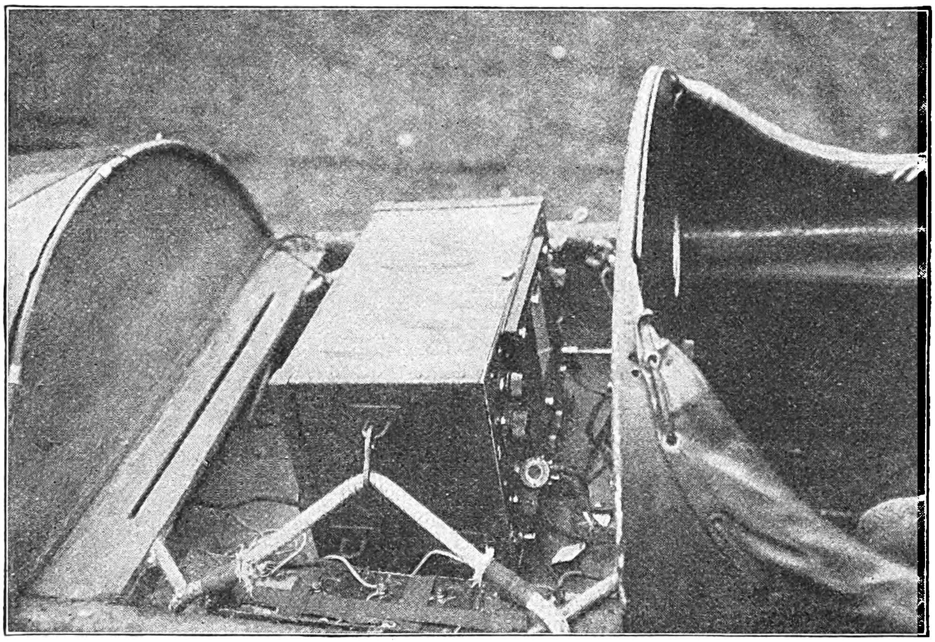
Here the instrument is removed from its case. The reeds show plainly. Note size show that he is back again between the edges of the beam from the radio-beacon transmitter.

Where the course between two airports two hundred miles or more apart is a straight line, radio marker beacons may be found about 25 miles apart. An airplane that flies regularly on such courses will have a radio-beacon indicator that shows an additional white line. This line may not remain steady like the two others, but may appear and disappear like the flashing light of a lighthouse. Its signals correspond with those of the beacon light in the same locality. The pilot, seeing the signal again and again on the indicator, can tell by a glance at his map exactly where he is. By noting his time of arrival at one marker beacon after another, he can tell what speed he is making and how much the wind is helping or hindering.

When the airplane reaches its destination and turns back toward the radio beacon that has guided it, the radio-beacon indicator on the instrument board is turned end for end. One end is marked "From Beacon" and the other end "To Beacon," so that no mistakes will be made.

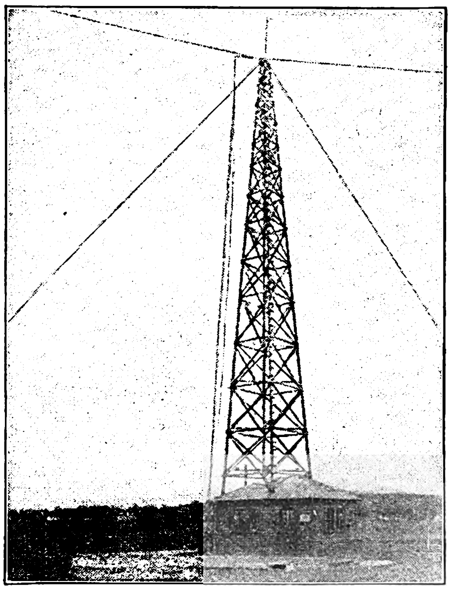
Besides keeping the plane on its course, and helping the pilot to find the course if he is not on it, the radio-beacon receiver also brings to the pilot information concerning the weather ahead. He may, if he chooses or if he is ordered to do so, wear a helmet in which ear phones are installed. He carries a schedule showing the times at which weather reports and storm warnings are to be sent by radio telephone from the radio-beacon stations or from other stations.

At the appointed time, he turns a knob on the instrument board or, if the radio receiver is within easy reach, he turns a knob on it. In either case the knob is stopped at the proper place for bringing in the weather report.



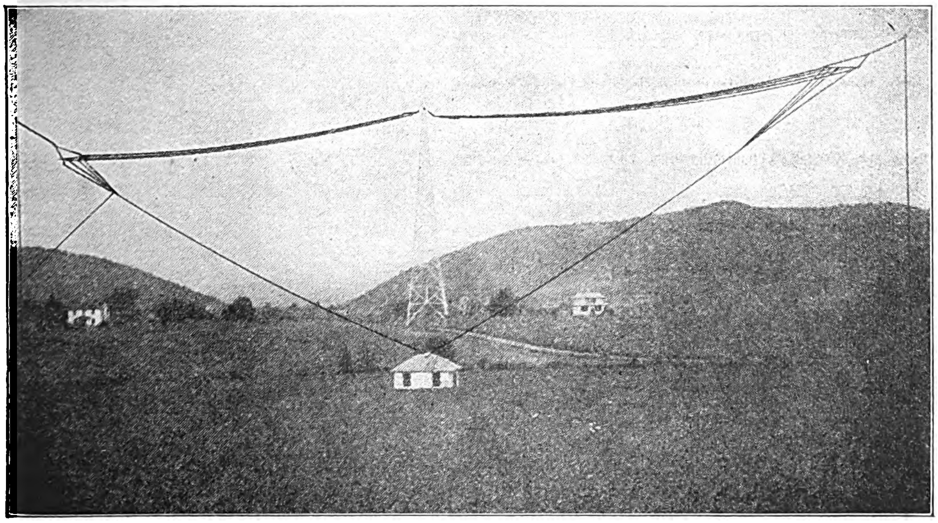
THE RECEIVER

This part of the equipment, permanently tuned, is located wherever convenient



TELEPHONE TRANSMITTER

From this remote controlled station at Bellefonte, Pennsylvania, are sent weather reports and the like, for warning pilots



RADIO-BEACON SIGNAL STATION

These towers and aerials are located just outside the landing field at College Park, Maryland. From here the narrow radio beam goes forth to guide aviators unerringly safe to port

There is no fishing for stations. When he has heard the weather report, and any other information that is being transmitted for the use of pilots in the air, he turns the knob back to its original position.

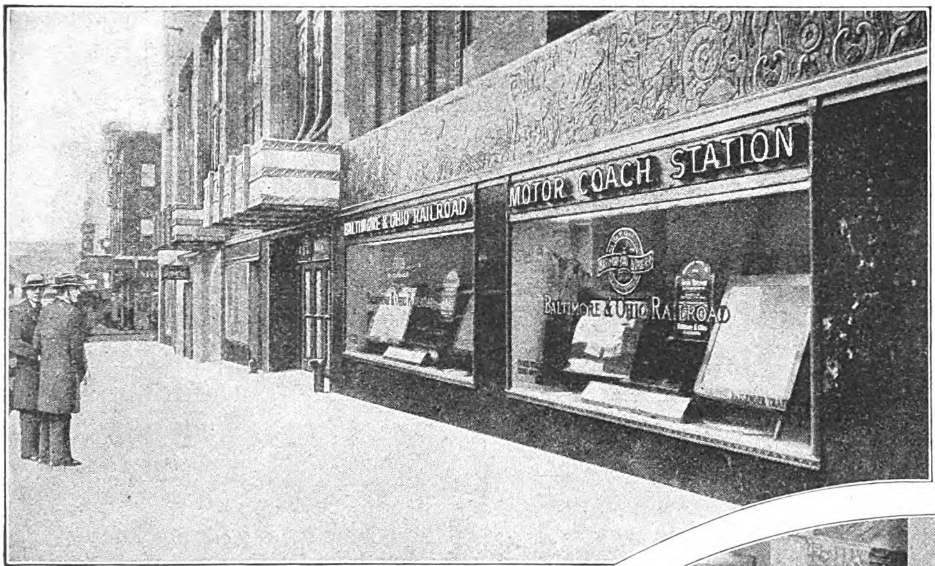
In early experiments with aircraft radio beacons, signals from the beacons were received through ear phones instead of with the visual indicators now in use, but this method was discarded. Continual listening was too hard on the pilot.

The reason for the action of the white lines on the face of the radio beacon indicator is easy to understand. The beacon transmitter sends out two radio beams like invisible fences on either side of an invisible road, in the air. When the ship steers too close to the fence at the right, the vibrating reed on that side becomes excited, vibrates more strongly, and makes its white line longer.

The radio beacon indicator is one of the final instruments needed on the instrument board to make flying safe and to make the airplane a dependable means of transportation. Pilots often are obliged to depend on "instrument flying" when they cannot see the ground. The altimeter shows a pilot his altitude. The tachometer shows him the speed of his engine. The air-speed indicator shows him his speed in the air but he can only guess at his speed over the ground unless he knows exactly where he is from time to time. The bank and turn indicators show when the airship is banking and turning. The compass shows the general direction. But none of these, nor all of them together, show whether the ship is on or off its course, which is what the radio beacon does.

New York's New Railroad Bus Station

Motor Coach Service, a Permanent Link in a Great Railroad System, Has a Fine New Terminal In Manhattan



STATION FRONT AND ENTRANCE

The attractive entrance of the new motor coach terminal on 42nd Street, New York City

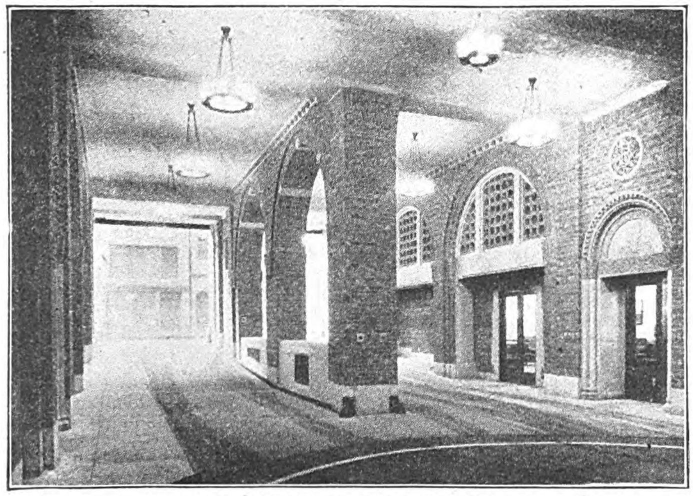
ON December 17, 1928, the Baltimore and Ohio Railroad opened opposite Grand Central Terminal and the Hotel Commodore, New York, a modern station to care for its ever-increasing motor coach traffic from its rail terminal in Jersey City to Manhattan. The new station is but a few doors away from the smaller Train Connection Motor Coach Service terminal the railroad had used since August, 1926. This service is an integral part of the railroad's service, only passengers to and from New York being carried in its buses; holders of regular tickets ride these buses without extra charge.

The main lobby of this station is impressively attractive and reminds one of a luxurious hotel lobby. While the decorations are, mainly, modernistic, large leather-upholstered chairs and settees give an air of spacious comfort. The lighting is indirect from modernistic chandeliers and column units.

The passenger buys his ticket in the main lobby, checks his luggage directly to his Pullman seat in the train, goes to the waiting room in the rear, and awaits his bus. The buses enter the building from 41st Street, discharge passengers, are turned around upon a turntable, are loaded, and driven out a door beside that through which they enter. Busses stop at another station and at hotels enroute.

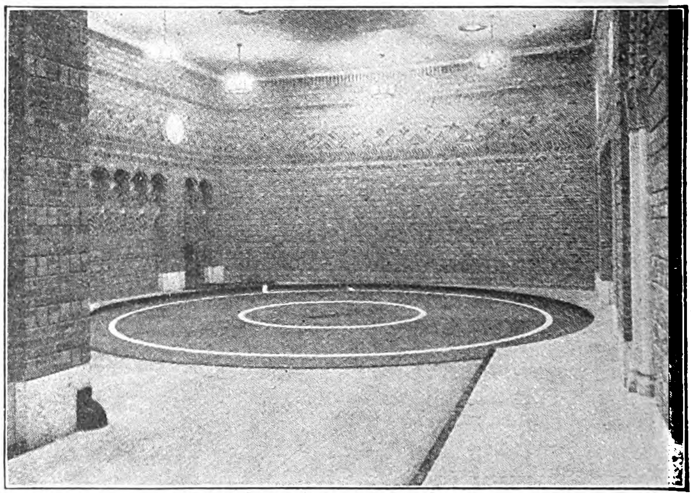
MAIN LOBBY AND TICKET COUNTER

Doors in the rear lead to waiting room, loading and unloading platforms, and retiring rooms. A stairway leads to tunnels connecting with subway system



BUS ENTRANCE AND EXIT

Motor coaches enter at the left, discharge passengers, turn on the turntable, and receive outgoing passengers on the right platform



ELECTRICALLY-OPERATED TURNTABLE

When a motor coach is driven upon this 30-foot circular table, the throwing of a control lever turns the table in less than a minute

Super-High-Speed Alloy

New Tool Metal, Next to the Diamond In Hardness, Solves Many Machining Problems

DR. SAMUEL L. HOYT

Dr. Hoyt holding glazed porcelain and Bakelite cut with Carboloy; cutters, made of the new tool metal, are in his right hand

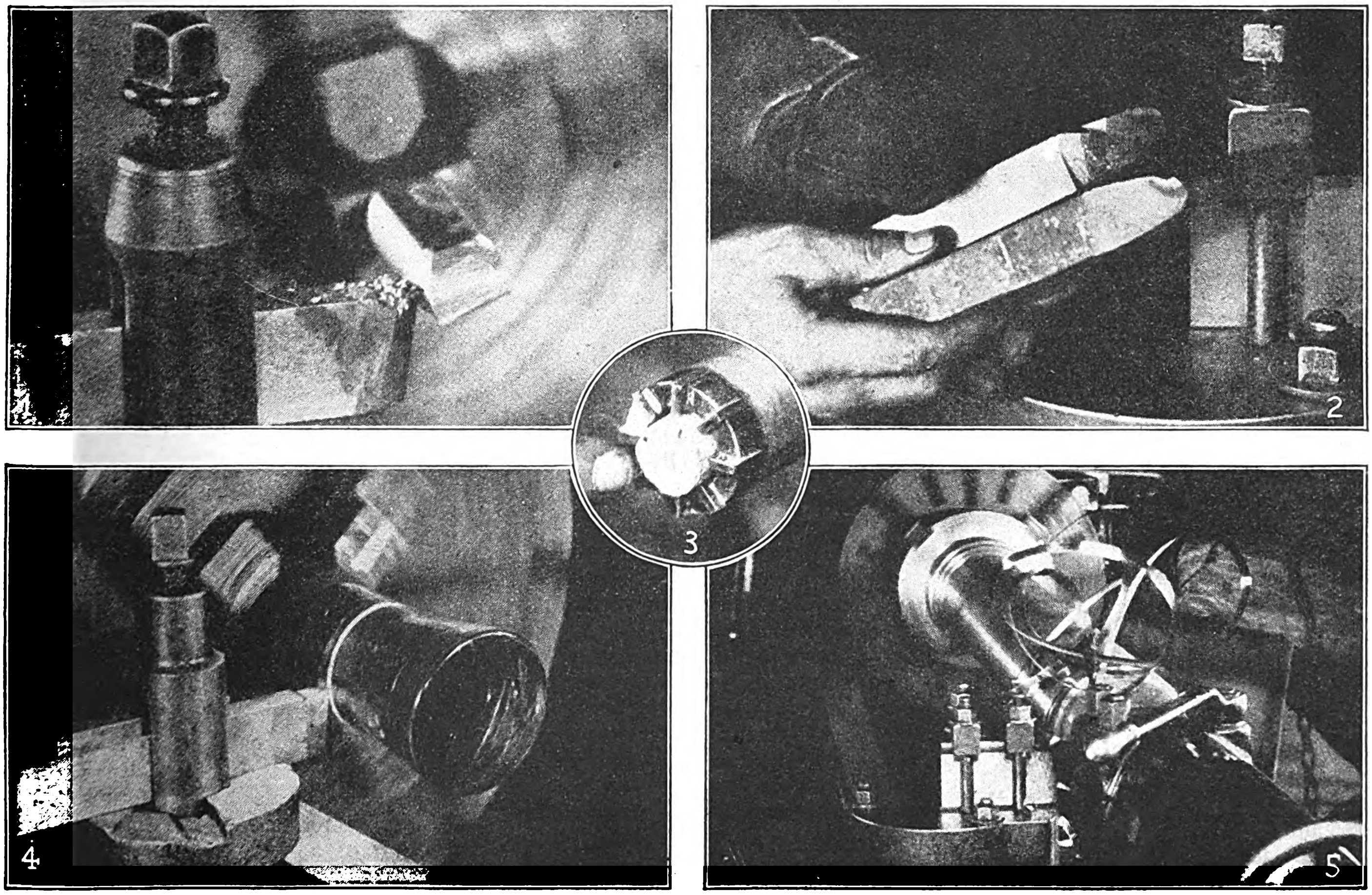
CUTTING a screw thread in a glass rod; boring a smooth hole in a block of concrete, handling porcelain in a lathe, and cutting the hardest of steels—operations that are difficult or even impossible with present-day machine tools—are among the things that can be done easily with a new kind of machine tool material recently announced by Dr. Samuel L. Hoyt of the General Electric Company. The new material, called Carboloy, is composed of tungsten carbide and cobalt, the carbide being extremely hard and the cobalt giving it the necessary strength for cutting tools. Carboloy now sells for around 500 dollars a pound and it is, therefore, used only in tipping machine tools.

Dr. Hoyt said, "The peculiar virtues of tungsten carbide promise to make it the dominant tool material in the field of weak, or 'low tensile,' materials which are also uncommonly abrasive to present tools. The new material can machine harder and denser grades of steel than can be handled economically by high-speed steel; and steels not now commercially machinable will be brought into the machineable class."

Usual cutting tools will not affect a glass rod; instead, a rod of glass in a lathe will wear off the edge of a cutting tool pressed against it. The Carboloy tool quickly cuts into the glass, and can be used for cutting a screw thread in the rod. Likewise, porcelain can be machined on a shaper with it. A Carboloy drill for drilling holes in concrete or rock is less expensive than a diamond drill and cuts a smoother hole than a star hammer drill.

ONE important use for the new alloy is in the cutting of molded materials, such as hard rubber, fiber, et cetera, containing metal inserts. Striking the inserts at high speed, ordinary tool metal is rapidly dulled, and even the best previously used for this work require sharpening after machining 150 parts, whereas Carboloy tools have cut 11,000 parts before they required dressing. Other materials so soft that they can be whittled with a knife but also so abrasive that they quickly destroy the cutting edge of ordinary tool steel, are easily machined with Carboloy tools.

The photographs below show: (1) Cutting a high-speed steel cutter in a lathe with Carboloy; (2) Comparison of high-speed steel and Carboloy after use on nickel-steel test log—the steel cutter (lower) is burned while the Carboloy cutter has not been affected; (3) Carboloy drill with core of concrete; (4) Cutting glass on a lathe with Carboloy; (5) Testing Carboloy cutter on a nickel-steel test log. This last test is a very severe one and would quickly destroy the edge on high-speed tool steel. Note the thick ribbons of metal being cut with Carboloy.



The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Milk Sickness

ABRAHAM LINCOLN'S mother apparently died from a disease which is still attracting much attention from physicians because of its strange symptoms and little understood nature. In pioneer days poisoning from the plant called snakeroot caused an appalling loss of human life. The earlier settlers were not quite certain just what brought about the condition. Apparently it was traced to milk coming from cattle which had eaten a plant known as the white snakeroot or *Eupatorium urticaefolium.* When the cattle ate the plant they were afflicted with the condition called "trembles." In the southwestern portions of the United States, a similar condition results from rayless goldenrod called *Aplopappus heterophyllus.*

MILK SICKNESS LOCALE

A typical habitat of *Eupatorium urticaefolium,* the plant which causes milk sickness, apparently through the milk of cows which eat it when they are foraging

In a recent investigation of the condition, made by Drs. Bulger, Smith, and Steinmeyer of St. Louis, it was revealed that the usual course of the disease is onset with restlessness, weakness and exhaustion, dizziness and vomiting. Soon intense thirst prevails, the weakness increases, the liver enlarges, the tongue becomes swollen, convulsions follow and finally, death after unconsciousness for two or three days, or even one or two weeks. The acute attack is so severe that even those who recover sometimes remain weak for years.

Modern scientific medicine studies such conditions by thoroughly investigating the changes that take place in the blood and in the excretions of the body. These studies now reveal that there is a very much lessened amount of sugar in the blood during the acute stage of this disease, and that the conditions which develop are quite similar to those that follow an overdose of insulin, which also lessens greatly the amount of sugar in the blood.

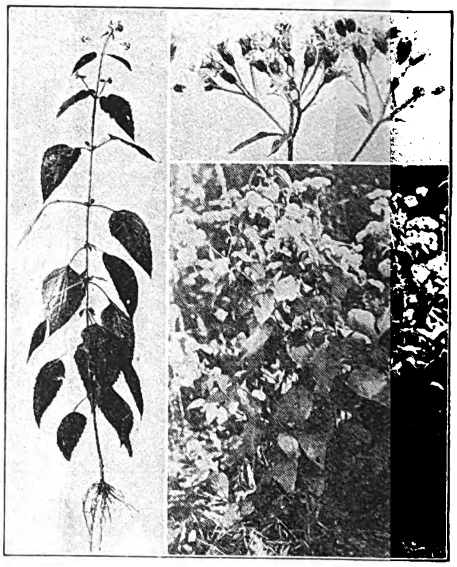
The plants, as seen in one of the illustrations, grow in woodlands and deep valleys and thrive especially where shade is abundant. Two years ago, out of a family of six using milk from cows pastured in the woods shown in the illustration, five died of the disease. As is well known, severe exercise makes a great demand on the sugar metabolism of the body. Hence a person recovering from this disease is warned against taking up work too soon. The father in the family of six, who was the least ill and had improved somewhat, felt that his farm work should be resumed. He got up and ploughed. That night he became much worse and died on the following day.

Effects of Rays on Tissues

THE investigators of the use of ultraviolet rays have been attempting to determine whether the effectiveness is dependent on the length of the wave used or on the dosage of rays given. The factor which decides whether the effect of the ray is to be stimulative or inhibitive seems to depend on the quality rather than on the quantity. A number of investigators, including some of the leading men in the field, have found that it is possible to produce both types of effect with the same region of the spectrum and they argue that the matter of dosage is of the greatest importance in determining whether the effects shall be stimulation or depression.

In order to study the matter more closely, Dr. Marie A. Hinrichs of the University of Chicago tested the effects of radiation on growing yeasts. Earlier studies reported that the exposure of growing yeasts to ultraviolet radiations produced only depression of the sugar-fermenting power. The newer investigators indicate that either stimulation or depression may be produced, shorter dosages giving stimulation and longer dosages giving depression. After an interval of several hours or longer the substances return to the normal, but in some cases permanent inhibition followed and recovery did not occur. When the effects were temporary, a gradual return to normal was found to be followed by a slight advance beyond the normal in the other direction.

After the work with yeast was completed, studies were made on the effects of radiation on cell division, on embryologic development, and on physiologic process. In every experiment it was found that short exposures to radiation stimulate and longer exposures depress the activity.



REPRESENTATIVE SPECIMENS

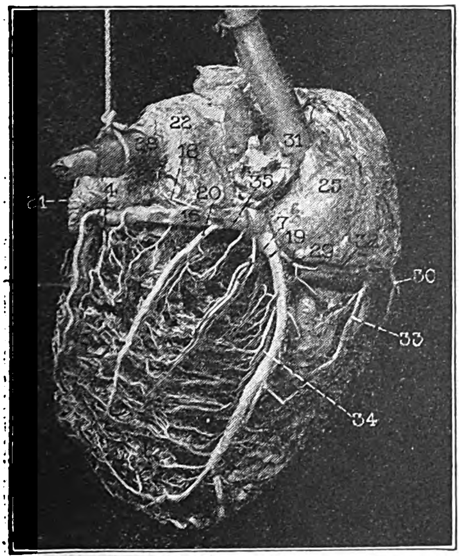
White snakeroot, *Eupatorium urticaefolium,* usually more branched than shown here. See also photograph at left

An Unusual Drug

DURING the past year medical periodicals have contained numerous references to the extraordinary action of a drug known as thallium acetate. The chief use of the remedy seems to be in afflictions affecting the scalp, in which it is necessary to remove the hair. This applies particularly to the disease known as ringworm of the scalp which affects children, passing from one to another in schools. When the drug is given in proper dosage to the child, the hair will start to fall off in from nine to fourteen days and in about three weeks all of the hair will have disappeared from the head. After about four weeks, the hair starts to grow again and returns in as good condition as it was previously. During the period when the hair is absent, it is possible to apply the proper antiseptic drugs to kill the organisms responsible for the condition of the scalp, and thus to bring about a cure of the disease.

The Circulation of the Heart

FROM the beginning of man's earliest knowledge of the human body, the heart has attracted a major portion of attention. The ancients conceived it to be the seat of the soul. Everyone knew that if it stopped beating, the human being would die. Just as soon as it become possible to dissect the human body, the heart was studied by that method. When animals were employed for experimentation the chests were laid open and hearts observed actually at work. In modern times other methods are involved, including the injection of dye substances into the blood vessels, the use of the X ray, of the microscope and of other technical apparatus.



CELLULOID HEART CAST

The ramifications of the heart of a ten year old girl are indicated by this intricate cast made by the process described herewith

A review of all of these methods has recently been made by Dr. M. B. Whitten of the Mayo Foundation who adds to previous methods a technique which he has developed for injecting the blood vessels of the heart with celluloid, dissolving away the tissue and leaving *en masse* a cast which reveals the manner in which the heart receives its blood supply. The importance of keeping the heart in good condition and with a full amount of blood will be realized from the extent of its circulation. The arteries are numerous and their ramifications profuse. The illustrations reveal the nature of this blood supply.

Do Eskimos Catch Cold?

DURING a trip up the west coast of Greenland, physicians from the Washington University Medical School in St. Louis noted that in certain settlements every native had a cold, whereas in others none of the Eskimos seemed to be afflicted. It was found that in the case of the villages in which all were afflicted, some one had come in from the outside world previous to the visit of the expedition. In the instances in which none of the natives were afflicted on the arrival of the expedition, in practically every case, within from 48 to 72 hours after arrival, all of the Eskimos had colds, with sneezing, coughing, and spitting.

Among these Eskimos colds are quite infrequent and diphtheria and scarlet fever occur rarely. Skin tests were made on the natives to discover whether or not they had resistance to scarlet fever and diphtheria, and it was found that in some instances the children had in their blood substances enabling them to resist these diseases, so that apparently some immunity is derived from the parents.

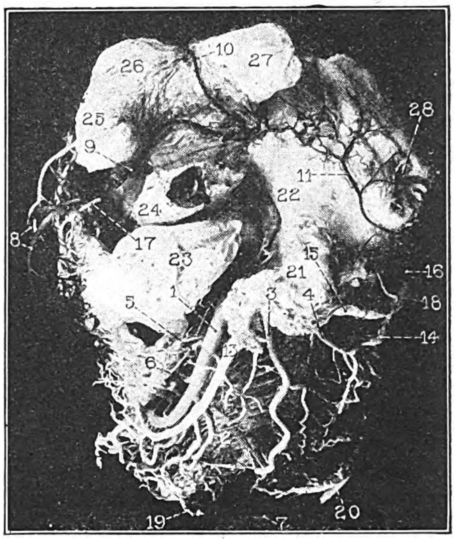
It has long been known that tribes of natives not previously in contact with the white man suffer severely with his diseases when they are introduced among them. Thus the Fiji Islands at one time were absolutely devastated by measles when the disease was brought in by outsiders. This condition, which, in the average white man, assumes a mild form, proved intensely fatal to a tribe which had not previously suffered from it.

When an epidemic of colds occurs in an Eskimo group, all who are without resistance get the colds. They recover and are not likely to have colds again unless a new strain of germs is brought in by other visitors.

Carrion's Disease

IN Peru, South America, there is a disease called oroya fever. In 1885 a medical student named Daniel A. Carrion attempted to establish the fact that this disease was similar to a condition called oroya fever and verruga, or "Peruvian warts." He inoculated himself in both arms with tissue juice taken from Peruvian warts, developed the fever and died, proving his point that the two diseases were the same. Since that time Barton, a Peruvian physician, discovered in the red-blood corpuscles of the patients with the disease certain rod shaped bodies which proved to be bacteria now called *Bartonella bacilliformis.*

Another American entomologist, Charles H. T. Townsend, showed that the disease was transmitted by a gnat which is now called *Philebotomus verrucarum Townsend.* The history of this disease is a demonstration of the manner in which scientists in many places co-operate to establish definitely the nature of the diseases that afflict mankind from their causes to the methods of transmission, their symptoms, and finally their methods of control. In the development of our knowledge regarding Carrion's disease another investigator gave his life; others gave of their energy and toil with but little hope of material reward.



ANOTHER CAST

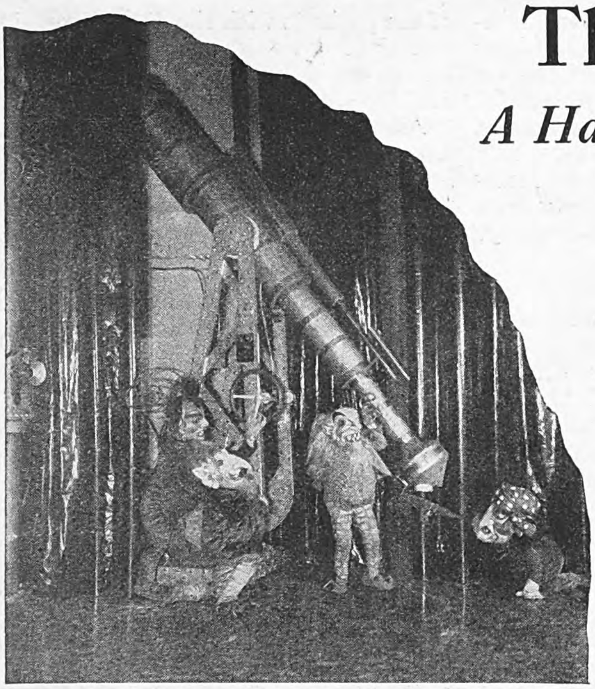
This one was taken of the heart of a 44 year old woman. Compare with the ten year old girl's heart cast shown in the column at the extreme left of this page

Home of Dr. Ephriam McDowell

IN Danville, Kentucky, in 1809, Dr. Ephraim McDowell, an American physician, did the first operation that was ever done on a woman for removal of the ovaries. The house in which this operation was done still stands in Danville. It is owned by a citizen of Danville and is occupied as a negro tenement. For many years attempts have been made to purchase this home in order that it might be established as a memorial to this pioneer surgical effort. The owner has unfortunately placed a prohibitive price on the property and apparently public sentiment has been insufficient to move him. The Danville Chamber of Commerce has attempted to acquire the building, which at the time the ovarian operation was first performed stood in the wilderness. In the history of American medicine this building is a monument indeed worthy of preservation.

The Devil Motorizes

A Hades of Iron and Steel, and Assorted Imps, Occupy the Stage

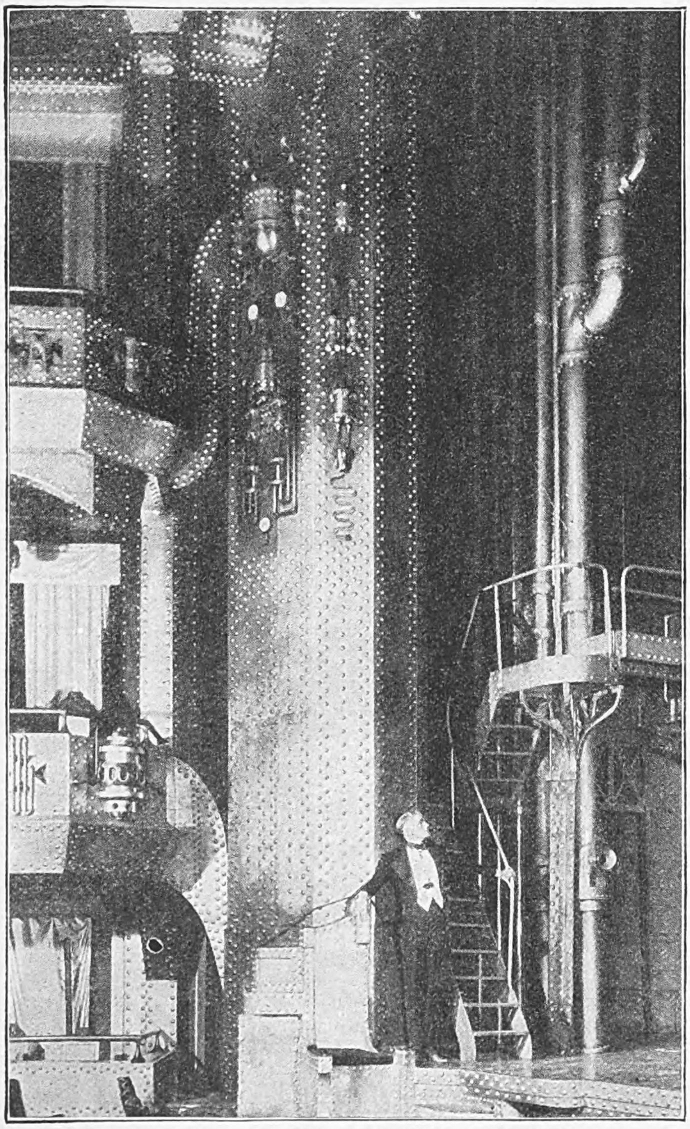


THE TELESCOPE LOOKS EARTHWARD

An apparently real and solidly constructed telescope is used in an attempt to locate a pure man on the earth

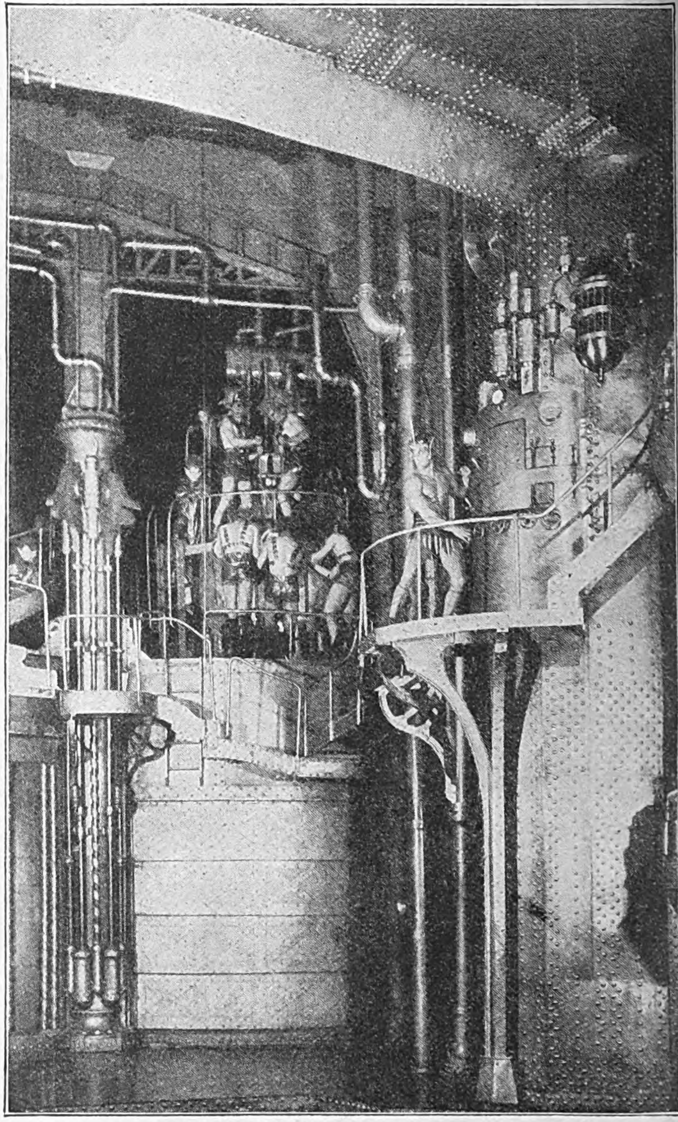
"MIMA" is a play in three parts and many scenes adapted by David Belasco from "The Red Mill" of Ferenc Molnar. It really is a miracle spectacle dealing with basic rather than merely surface emotions. To get away from the hackneyed eternal triangle, the tales of conjugal misfits, and the plotless drawing-room dramas was Mr. Belasco's problem. In "Mima" he does not stop with the stage, he comes right out into the audience and makes his proscenium arch the chord of a bridge. His boxes might be gun ports on a battleship and his stairs and runways suggest the engine room of a great transatlantic liner. The audiences are two in number, the paying guests—the audience—and the Devil and his court, for the scene is laid in Hades, Hell or whatever you want to call it. "Mima" is the superbly beautiful composite of the very dregs of sin. She is a manikin, the product of thousands of years of experiment by Magister, super-scientist of Hades.

But even Mima is but a part of Magister's scientific triumph. He has labored for 500,000 years to construct a huge apparatus, a complicated mill which he calls his "psycho-corrupter" and which he guarantees will transform the purest of souls into complete fiendishness in the space of one short hour. Rex Infernis and his



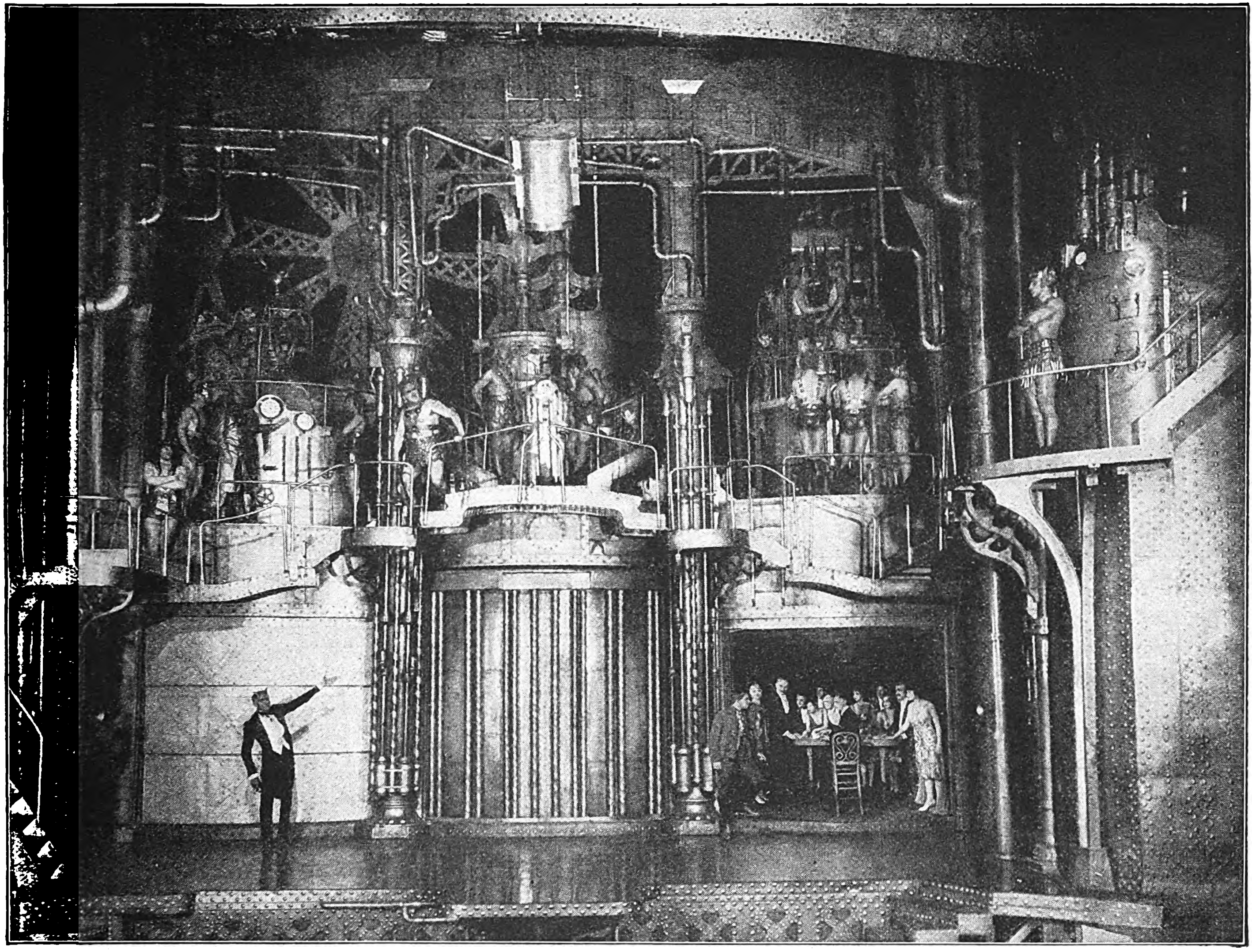
THE TWO HORNED INVENTOR ADMIRES

The stage and the boxes look like the big gun bay of a battleship. Shining riveted armor and Geissler tubes make a weird scene



WITHOUT BENEFIT OF PAPIÉR MACHÉ

The "psycho-corrupter" or soul destroyer, required a number of months to build, involving the manufacture of much machinery



THE GREAT MACHINE PROVIDES LITTLE STAGES

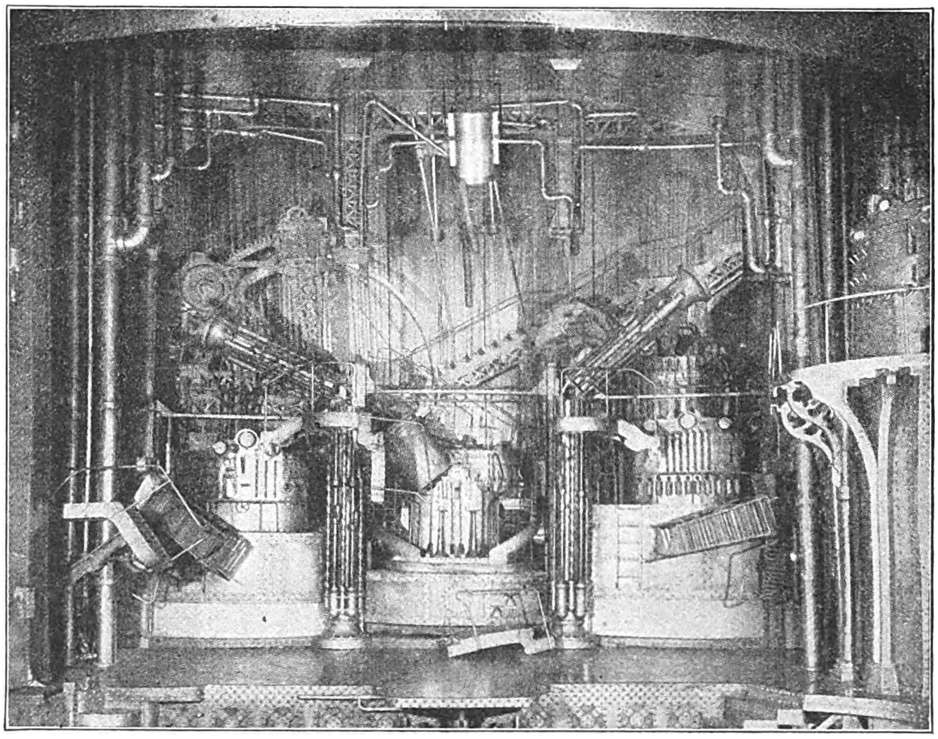
There are three cylinders which afford three bays for the setting of scenes. The doors rise and fall, or in the case of the center, rotate. All the various human emotions can thus be displayed to the devil and his entire court who occupy the "first row" in the orchestra

retinue of lesser devils come to witness a demonstration of the apparatus.

A soul is needed for the test, and Satan and his court inspect the world through a huge telescope to determine the identity of the victim. Finally Magister discovers his perfect man, Janos. Two of Hell's fiends are sent to bring this man before Satan and his court. Magister, now in the rôle of the proud scientist demonstrating his invention, plays his vari-colored lights on Mima who comes to life and instantly begins portraying all the rôles of womankind.

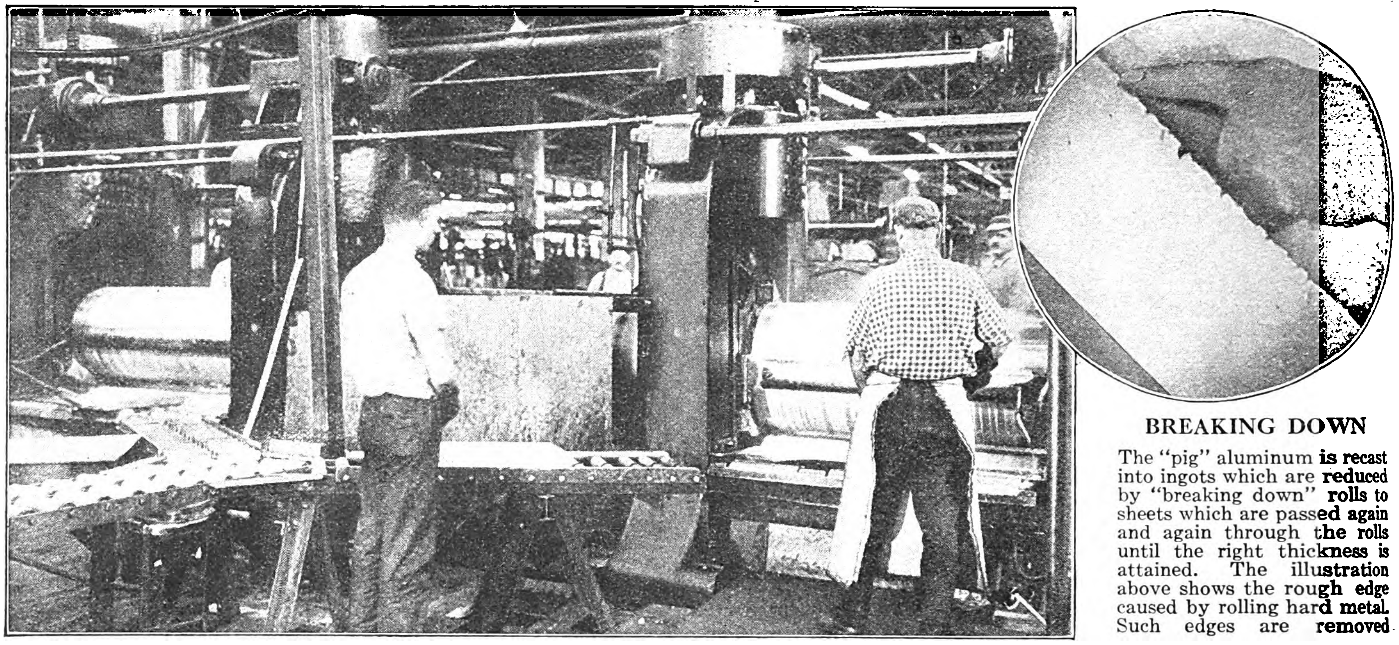
Presently Janos is dragged before Hell's dignitaries and thrust into the soul-mill. To shorten a long story the hero is thoroughly corrupted. He sins in every possible way and finally determines to kill his temptress but she eventually wins his forgiveness. Instantly Hell is thrown into a tumult.

Amid terrible noise and confusion the soul-corrupter becomes a mass of wreckage, the temptress becomes a manikin and the upright forester who is the hero returns to his humble home having experienced a whole life time in an hour.



THE INVENTOR'S DREAM IS SMASHED

The complete downfall of the machine is cleverly done, the great cylinders going down on individual elevators. The substantial runways and stairs are all mentioned in the text



BREAKING DOWN

The "pig" aluminum is recast into ingots which are reduced by "breaking down" rolls to sheets which are passed again and again through the rolls until the right thickness is attained. The illustration above shows the rough edge caused by rolling hard metal. Such edges are removed

Aluminum on Trial

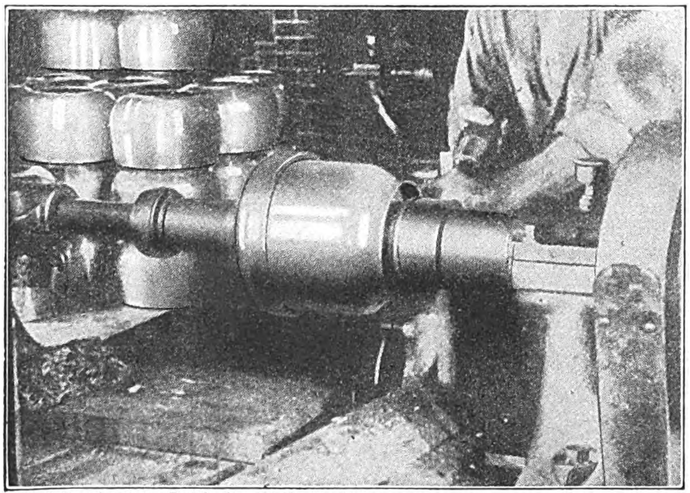
Cooking Utensils Made of Aluminum Are Shown to Have No Harmful Effects on Food

By ALBERT A. HOPKINS

THE first cooking utensils of aluminum were made in 1892 and the industry prospered with the lessening cost of the bright metal. About 1912 or 1913 someone raised a question about the use of aluminum. At that time there seemed to be nothing pernicious or persistent in the way of promoting propaganda against aluminum, but in the first part of 1926 a curious whispering campaign was inaugurated which tended to militate against the use of aluminum kitchen ware. Who started this propaganda does not seem to be definitely known but the results were and are very tangible and regrettable.

The utensils fabricated from aluminum were assailed as inimicable to health and in many a kitchen closet and garret will be found a battery of unused pots and pans made from the light material. Considering the friendly relations we of the SCIENTIFIC AMERICAN have always had with our readers, it is not surprising that we received many letters asking whether aluminum cooking utensils were harmful or harmless. At last it was determined to make a really scientific survey of the situation and the writer was assigned to examine all the evidence in the case. This involved a trip to New Kensington, Pennsylvania, one of the centers of the industry, so as to see what care is used at the mill to ensure a perfect product. This did not, of course, involve the chemical aspects of the case, but these were gathered at the Mellon Institute in nearby Pittsburgh.

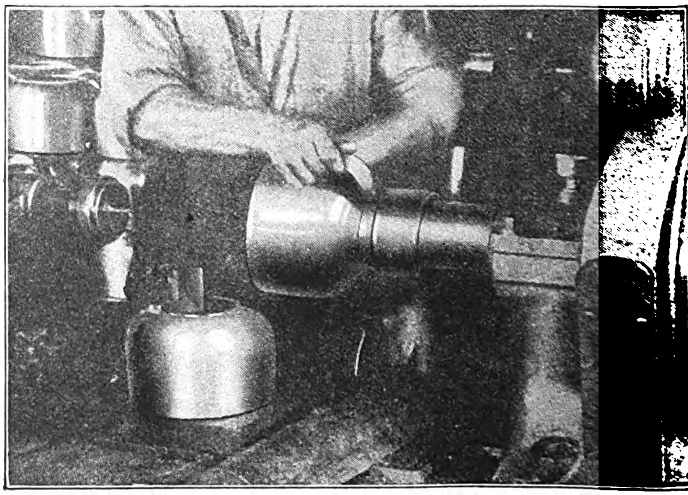
THE sum of our investigation is that there is no foundation for the belief that the use of aluminum cooking utensils is injurious. There is also no foundation for the absurd statement that aluminum or any other kind of cooking utensil has anything to do



All photographs courtesy The Aluminum Cooking Utensils Company

SHAPING A TEA KETTLE

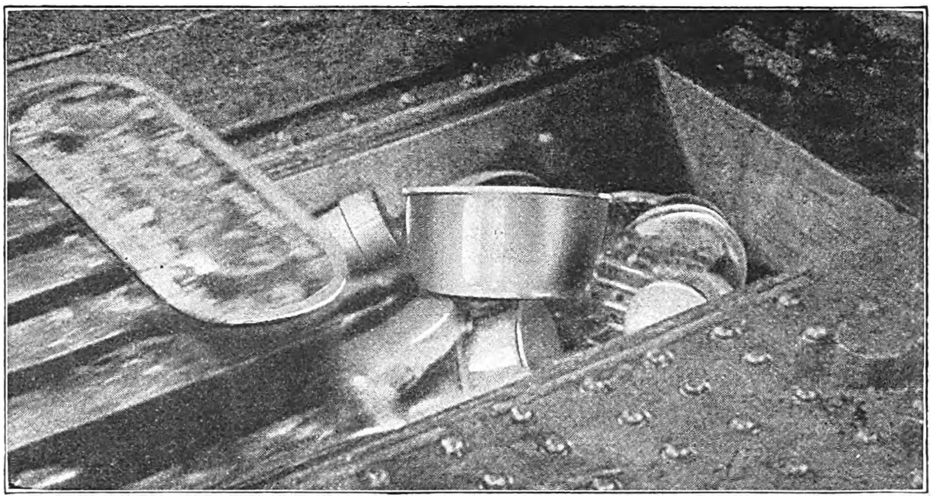
As the top is smaller than the body diameter, the utensil first has a purely cylindrical form which is finally shaped by "spinning"



THE KETTLE IS BORN

A collapsible steel form shaped exactly like the inside of the utensil shapes the metal to its final form by heavy pressure from outside with the causation of cancer. The American Medical Association, the United States Public Health Service, the London *Lancet* have all issued statements, or published articles which give aluminum a clear bill of health. So once and for all let us put away this bogey which should never have been discussed at all by intelligent people. Whatever or whoever may be back of the propaganda, the facts remain that aluminum has stood the test of time and today is in more universal use in hospitals and institutions than any other metal. Before proceeding to describe the processes of manufacture of the metal and the fabrication of the utensils we will consider briefly the chemical aspects of the problem.

IN 1912 the statement was advanced in England that aluminum cooking utensils were deleterious to health. The *Lancet*, the leading British medical journal, made experiments on the subject and stated editorially that this metal does not appear to be more susceptible to the action of water and foods in the process of cooking than does iron, which has been used from time immemorial as the material of cooking pans. As is well known, iron rusts very readily in the presence of water and air, while also it is attacked by organic acids. It is further well known that iron salts in large quantities are injurious to the human organism, as are also large quantities of aluminum salts, but there is no evidence to show that in the ordinary cooking operations of every-day life either iron or aluminum is so strongly attacked as to produce an objectionable amount of soluble salts. All that can be found, even when organic acids and mineral salts are present in the cooking pan, are the merest traces of metal in its soluble state. The alumina precipitated by ammonia in the tests was in practically all cases an unweighable quantity.



SCRAPPING THE IMPERFECT

On account of the hard sheet metal used, many pieces are torn or broken. The mortality of aluminum utensils is great. The "cripples" are ruthlessly scrapped by the watchful inspectors

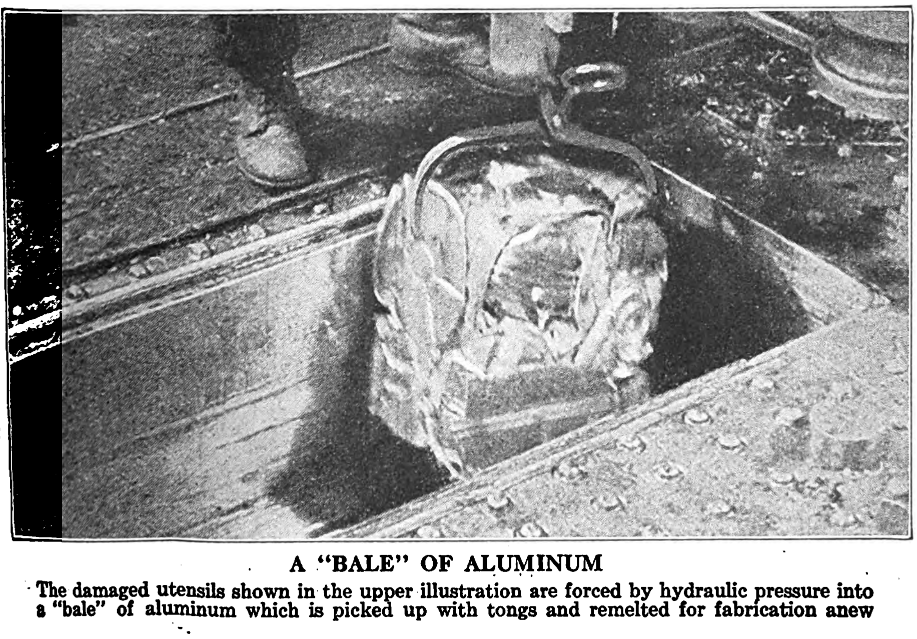
The *Lancet* states that aluminum, as it is now made by reputable manufacturers, is a suitable material for cooking vessels and that any suspicion that it may communicate poisonous qualities to food in the process of cooking may be safely dismissed in view of the results of the practical experiments which have been recorded, showing that the metal is not appreciably acted upon in cooking operations. Aluminum is also an excellent heat conductor, so that cooking in aluminum vessels is therefore rapid, and fuel is economized in consequence.

THE *Journal of the American Medical Association* states that investigations made in Great Britain under the auspices of the Medical Research Council, indicate that cooking, even of acid fruits and vegetables for long periods of time, in aluminum ware, showed so little aluminum in the juices after cooking that it required the most delicate chemical tests to indicate its presence. Indeed, not only the fruits but the actual acids themselves were boiled in aluminum ware without accumulating more than slight traces of aluminum.

Dr. George D. Beal of the Mellon Institute of Industrial Research of the University of Pittsburgh, says: "Aluminum is at the present time the most widely used constructional material for cooking utensils. During the time that it has been in use, it seems to us that the harmful nature of this metal would have become increasingly apparent to food and medical specialists. Strange to say, the only two who have found any existence of such a condition are a dentist in Toledo and an advertising physician in Chicago who has been connected with many so-called 'health institutes.'

"I have used aluminum in my home almost exclusively during the past 15 years and fail to see where the health of my family has been injured in any way. Dr. Geo. W. McCoy, Chief of the Hygienic Laboratory of the United States Public Health Service, Treasury Department, Washington, D. C., tells me that in his opinion there is no evidence to support any claims as to the harmful qualities of aluminum, and his department habitually gives an answer of this type.

"OUR own experiments as to the quantities of aluminum removed from utensils by cooking foods therein show that the quantities of aluminum removed are so small that they are not significant unless reported as parts of aluminum per million parts of food. These quantities are of the same order as those in which aluminum normally occurs in food stuffs and are in many cases far less than those observed in many public water supplies which have not been subjected to chemical treatment for purification. I mention this since the usual chemical method of clarifying water consists of the addition of aluminum and lime, and is alleged to increase the aluminum content of the water."



A "BALE" OF ALUMINUM

The damaged utensils shown in the upper illustration are forced by hydraulic pressure into a "bale" of aluminum which is picked up with tongs and remelted for fabrication anew

The *Chemiker Zeitung* in an article entitled "Aluminum Cans for Preserving Foods," says:

"The results of a large number of tests upon the preservation of various fruits and vegetables in aluminum cans are recorded. In all cases the cans were much less attacked by the fruit acids than is the tin in the usual tin-iron cans. No deterioration in the taste, color, odor, or edibility of the foods was noticed, and the very small amount of aluminum dissolved in prolonged preservation has no toxic action."

How Aluminum Kitchen Utensils Are Made

ALUMINUM has peculiar properties. It is one of the most malleable of metals, and like gold it can be drawn out into a very thin sheet or wire. This is on account of its great ductility. Under heavy pressure, even while cold, it can be pressed into desired shapes. This is called "drawing" and this operation makes the metal more dense and lustrous. This is why cooking utensils made by the drawing or stamping process are more dense and have a smoother surface than cast or molded utensils before being polished or buffed. Besides its lightness, hardness, and resistance to corrosion and chemical action, aluminum has another quality that makes it most admirable and useful for cooking utensils: this quality is the extraordinary ability of aluminum to absorb and conduct heat.

Today the manufacture of aluminum cooking utensils is a highly specialized industry employing thousands of workers who operate in huge plants. Here the product of the clay-like ore is converted into the glistening saucepan or its more complicated companion, the tea kettle, in a plant far removed from the smelter. The only ore which is really pure enough to yield metallic aluminum on a commercial scale is bauxite, of which the largest and best deposits in America are located in Arkansas. In most metal-refining plants, the metal is usually separated from the rest of the ore by the very simple process of crushing, working, and smelting, but bauxite, or aluminum ore, must be carefully refined before it can be smelted. The bauxite is shipped to East St. Louis and converted by chemical process first to sodium aluminate and then to aluminum hydrate. The white powder which is about to become pure aluminum is shipped to Niagara Falls, Massena, New York, Alcoa, Tennessee, or Badin, North Carolina, where electrical current in large volume is available at a low rate. The final reduction in electric furnaces results in the production of metallic "pig" aluminum.

ON GOES THE SPOUT

If there is a spout, this is made separately and then welded to the utensil's body

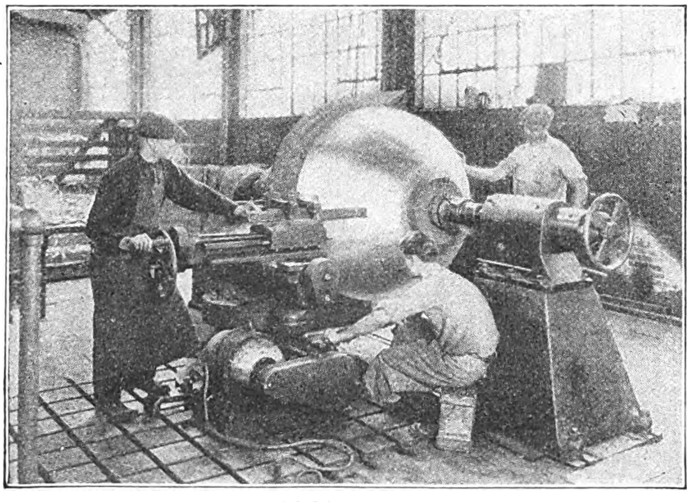
THE "pigs" of aluminum are then re-melted and cast into various forms, such as rods or ingots. The ingot is the starting point for aluminum sheets which are used in making cooking utensils. These are all made from sheet aluminum with the exception of some waffle molds, griddles, and articles produced by die casting. In sheet form it is possible to obtain hard, dense, uniformly thick aluminum utensils suitable for use in the kitchen.

The sheets are passed through gigantic rolling mills until they are reduced to the exact gage or thickness required, and during this process the metal is squeezed and compressed until it becomes dense and hard. Starting with the "blank," which is a circular or oval flat sheet of aluminum a little thicker than the final thickness of the utensil, it usually requires four or five stampings or forming operations to convert that sheet into a utensil of a straight or an inverted conical shape.

In utensils in which the top opening is smaller than the body diameter (as in a coffee pot or a tea kettle), the utensil first has a purely cylindrical form, and then is placed over a collapsible steel form shaped exactly like the inside of the finished utensil. By rapidly revolving the steel form and the partly formed utensil, while exerting pressure on the outside, the metal is shaped to the final form. The inside die, being collapsible and in several pieces, can be removed easily. If the utensil is to have a spout, this is made separately and then welded to the body. In the case of large steam jacketed kettles, the spinning operation is of great interest owing to the size of the tools required. One of our illustrations shows such an operation.

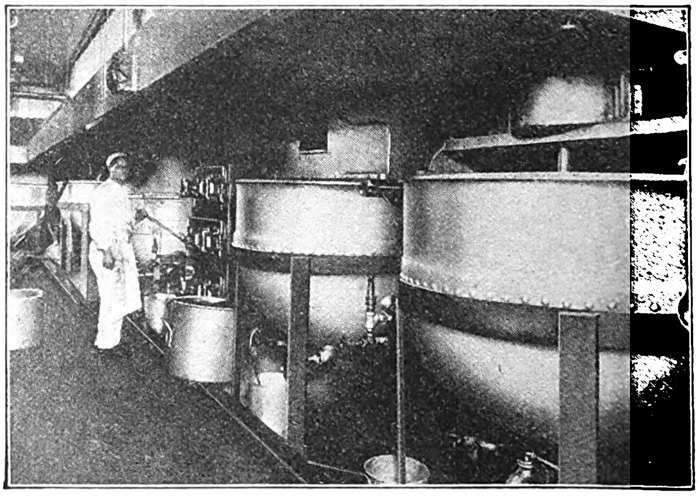
IN the process of manufacture from cold, hard, sheet aluminum many pieces are cracked and broken and are discarded and melted up as scrap aluminum; only perfect articles may pass to the kitchen closet.

So the interesting story of aluminum ends. From every viewpoint, lightness, economy in first cost and economy due to extremely long life, economy in fuel due to superior heat conducting and heat retaining qualities, and finally in safety from all harmful action of food acids, aluminum utensils for cooking are in keeping with the modern, progressive and scientific spirit of the 20th Century.



SHAPING A KETTLE

Aluminum spinning on a vast scale. Very heavy machinery is required to produce the shell of a modern steam jacketed kettle



ALUMINUM GOES TO WORK

Here we have great steam jacketed aluminum kettles making soup for canning. No metal is better adapted for this purpose

Seeking the Secrets of Lightning

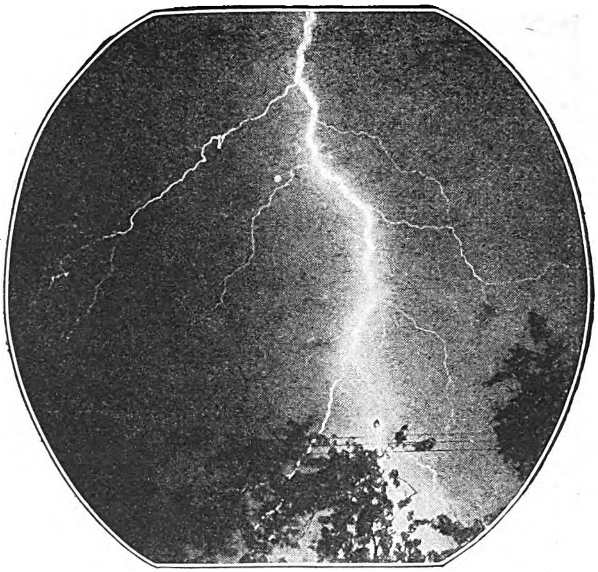
TO obtain "autographs" of lightning flashes and analyze them so that power transmission lines may be protected and interruptions of service prevented, investigations have been carried out for several years. In this country, the Westinghouse Electric and Manufacturing Company established in the summer of 1928 an outdoor lightning research laboratory consisting of two stations about five miles apart on opposite sides of the exposed end of the Chilhowee Ridge in the Great Smoky Mountains of eastern Tennessee. Records indicated that lightning is as severe and frequent in this locality as anywhere in the country. Also, a highly insulated power line runs over the ridge. The Aluminum Company of America and the Knoxville Power Company, owners of the line, co-operated fully in the plan and in the work of establishing the stations.

Chief among the instruments used in these stations is the cathode ray oscillograph developed by Dr. Harold Norinder of Sweden. The difficulty of using the usual type of oscillograph in lightning studies lies in the fact that the discharge lasts but a few millionths of a second and may occur at any time. Therefore scientists sought a relay which would turn on the oscillograph in less than one 100,000th of a second before the arrival of the lightning in order to prevent the fogging of the photographic film which would occur should the stream of electrons be permitted to strike the film in one spot for even that short period of time. Dr. Norinder modified the oscillograph itself so that no relay is necessary.

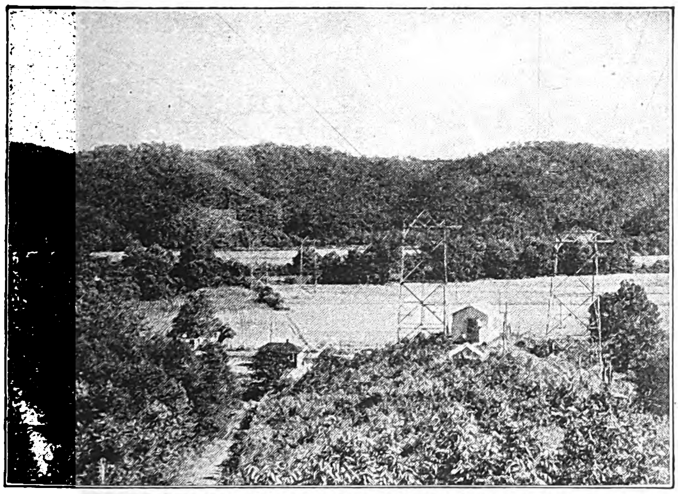
A Norinder oscillograph is located in each station and each is supported by klydonographs in the line on both sides. Microphones on each side of the stations are used to determine the location of the discharge by the noise of the thunder and an osiso is used to record the time difference between these and an antenna, at each station, which records the electrical disturbance. Cameras with "fish-eye" lenses are used to obtain photographs of lightning in any part of the sky.

Electrical storms were singularly rare during the summer of 1928 after the stations were established and only one flash was recorded and this reached a maximum of only 650,000 volts. The curve registered by this flash showed that it disappeared 50/1,000,000ths of a second after it began, having risen to its maximum in a few millionths of a second. The records obtained show everything necessary for a full analysis.

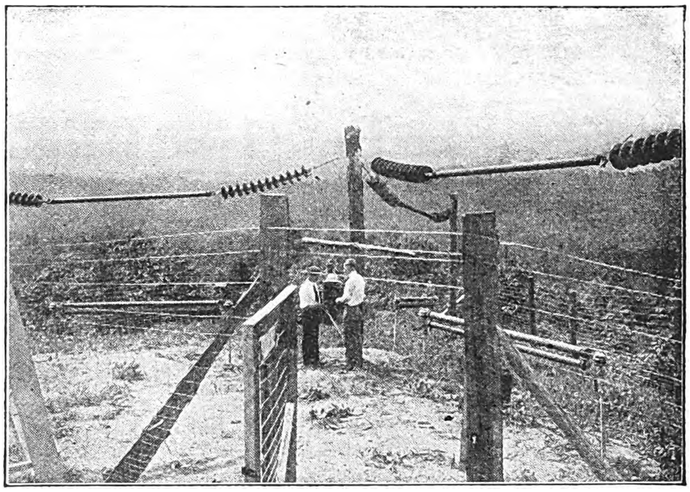
Mr. Atherton, an engineer of the Westinghouse Electric and Manufacturing Company, says that the knowledge gained from such studies of lightning "are of tremendous value to scientists striving to combat lightning. If reports come in from a hundred investigations in a hundred localities, then, and only then, can we hope for final victory over our ancient enemy, and the consequent benefits of cheaper, more reliable, and more abundant power." It is expected that the investigations will be continued in 1929 with, it is hoped, greater success.


THE POWER LINE'S ENEMY

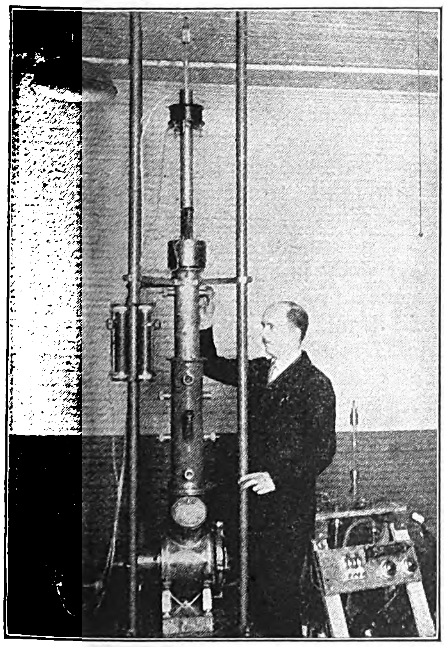
A blinding, powerful flash such as this, striking power lines, may interrupt service and rupture machinery


WHERE LIGHTNING IS PREVALENT AND SEVERE

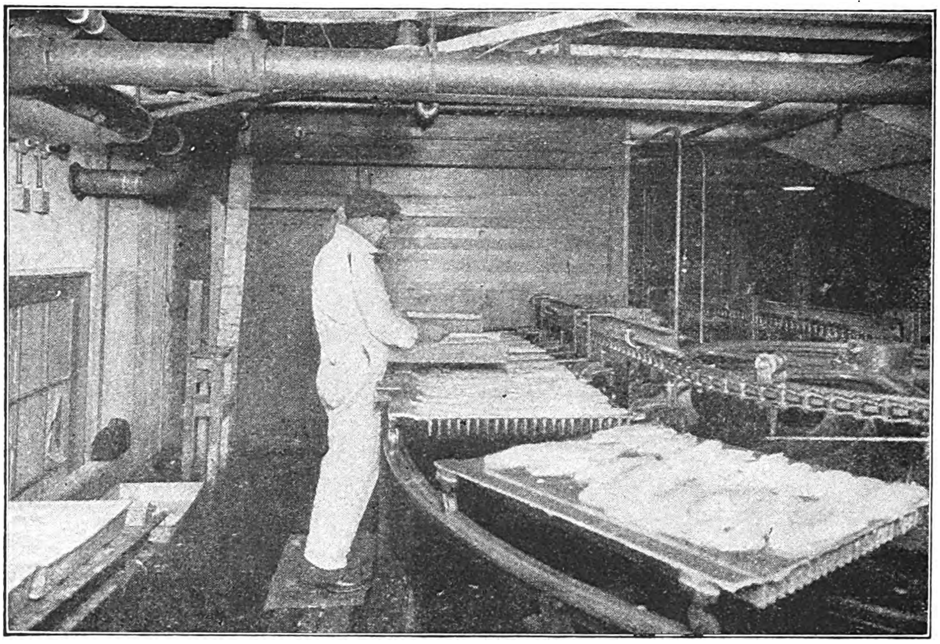
One of the lightning study stations on a knoll of the Chilhowee Ridge in the mountains of Tennessee. Note the transmission line


CHANGING THE FILM AT A KLYDONOGRAPH STATION

The klydonographs supporting the Norinder oscillographs verified the maximum voltage record of the latter instruments


THE NORINDER OSCILLOGRAPH

The instrument which made practicable the lightning studies undertaken last year



QUICK FREEZING OF FISH FILLETS PRIOR TO SHIPPING

In this automatic freezing machine, the plates are of aluminum with deep ribs extending downward. These dip into calcium chloride brine at about 20 degrees below zero, Fahrenheit

Science In the Distribution of Fish

One Of Man's Oldest Industries Rejuvenated By the Adoption of Scientific Methods

BY HARDEN F. TAYLOR

Vice President, Atlantic Coast Fisheries Company

FISHING is one of the oldest pursuits of man. Archeologists tell us that crude implements found among the relics of ancient man testify to their capture of fish food with such things as hooks made of thorns and splinters of bone, spears, crude traps and weirs, and even harpoons. In the centuries preceding our scientific civilization, the arts of catching fish with nets, and preserving them by salting, smoking, and drying were slowly developed. We who are in the industry may as well admit that even after scientific research had revolutionized many other industries, the fisheries were still extremely slow in grasping the opportunity of applying scientific method to the solution of their interesting problems, for even now some of the methods of salting and smoking are followed that were being practiced when Shakespeare was writing his plays and Walter Raleigh was trying to colonize Carolina.

The use of ice as a temporary preservative for fish is less than a hundred years old. Canning salmon, sardines, oysters, and a few other fishery products came with the development of hermetic canning of other foods, and the application of artificial refrigeration came into practice. But all of these things were forced on the fisheries from without rather than developed by initiative. Very little indeed was done by fisheries people themselves to originate new things of their own.

All this is now rapidly changing; new and important advances are coming about in the fisheries to such an extent that they constitute news of technical progress. This revolution may be an outgrowth of the increased demand for food occasioned by the World War, or, more likely, it is the eventuation of what must unavoidably have come to pass sooner or later—the realization of the immense spread of ocean, with its unlimited store of raw materials and vast receipts of sunlight for the photosynthetic production of food, the suitability of that food for human needs, and the growing demand for food by increasing populations.

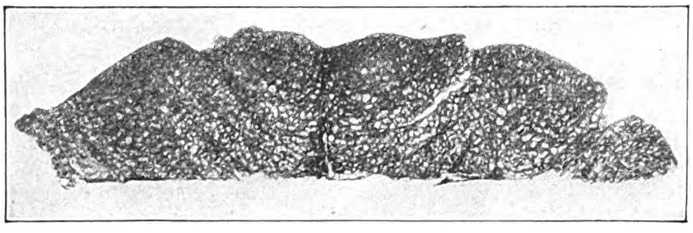
The problem of the fisheries has always been that of getting fish to the consumer in first-class condition. Everybody who goes fishing knows the delicious palatability of the fish he catches, if they are cooked and eaten promptly. And yet at home he does not particularly care for fish, especially if he happens to live a few hundred miles from the sea.

A TRADITION has grown up in many places that fish are to be eaten only in months the names of which contain the letter R, not because the fish are any the less edible or nutritious in summer than in winter, but merely because the technique of delivering it in good condition had not been perfected until recently. Furthermore, in the old-fashioned way, the entire fish, 60 percent or more being inedible and disagreeable, was shipped.

A secondary, but grave, difficulty has existed in the great inequalities of supply and demand, causing gluts of great amounts of highly perishable food at times, and at other times a great shortage and high prices. The fisheries industry could never occupy its proper place as a food producer until these two problems were solved.

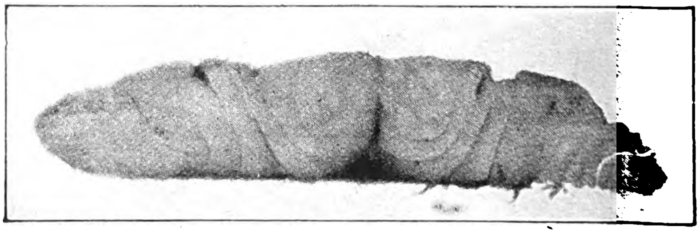
The new system, built by scientific research, is rapidly solving these problems by changing the whole system of handling fish, introducing not only modern methods, but some novel creations and processes originated by the industry.

The fundamental development in this field is in refrigeration. It has been found that there are two kinds of decomposition in fish—bacterial and autolytic or self-digestive. A temperature of 32 degrees arrests



SLOWLY-FROZEN FILLET

In the old process of freezing fish for many hours, large ice crystals formed in the flesh and ruptured it as shown in this cross-section



QUICKLY-FROZEN FILLET

By the new process, fillets of fish are frozen in about 40 minutes, the result being that ice crystals formed are of minute size neither, but merely retards them. To arrest them, much lower temperatures are necessary—but this necessitates freezing. It has been found that at temperatures around zero, Fahrenheit, freezing stops all chemical and bacterial change. But frozen fish are supposed to be inferior. Is this supposition well founded, or not?

The answer to this question lies in both the purpose and the technique of freezing.

In the older industry, when serious gluts occurred, the producers, struggling to save their fish, would freeze them to prevent total loss. It sometimes happened at such times that the fish were frozen after they had lost some of their original fresh quality. This practice of freezing fish that were already stale gave to the consumers the erroneous idea that the freezing itself was the cause of poor quality of the frozen fish.

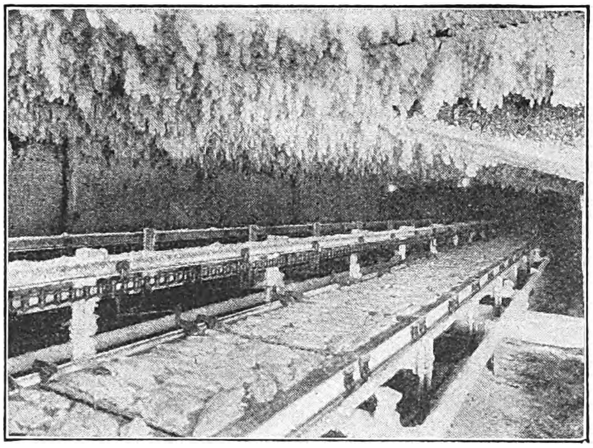
Furthermore, research has shown that the technique of freezing could be greatly improved so that, with perfectly fresh fish to work upon, a practically perfect quality could be delivered to the distant consumer. The older method of freezing consisted in putting the fish in a cold room and allowing them to freeze slowly.

During this freezing, the water in the fish (about 75 to 80 percent) is converted from liquid to solid, the solid assuming the form of ice crystals.

NOW we know from physics that, in slow crystallation, the crystals are large in size and few in number, while in rapid crystallization their number is great and the size small. In slowly frozen fish, therefore, the ice crystals are so large as to rupture the cell membranes and muscle fibers. The writer has pulled crystals an inch long from slowly-frozen halibut.

The resulting damage to the fish has the same effect as a bruise to an apple—the fish rapidly deteriorates when it is de-frosted. This difficulty is overcome by applying refrigeration so rapidly that such crystals as are formed are microscopic or sub-microscopic in size. When fish are frozen as rapidly as this (40 minutes as compared with 24 hours or more by old methods) it may be defrosted and no difference from fresh fish will be noted either by the eye or by chemical methods. It will have the same edible qualities as fish just out of the water. Such freezing does no more harm to the fish than it does to ice cream.

Other difficulties were encountered, however. A living fish, like any other living animal, is an extremely complex chemical laboratory where a great variety of chemical reactions are taking place. When the fish is alive, the reactions are controlled and in equilibrium. When it dies, some of these reactions go right on, uncontrolled, to the detriment of the fish flesh. For example, just as the pepsin in the stomach will digest the stomach itself if the blood supply is stopped, so the enzymes and secretions of the fish, when circulation of blood is arrested by death, proceed to act on the tissue themselves and decompose them. Because of these facts, even when the fish is quickly frozen, after a short while the body juice begins to separate from the fiber, and the whole turns a yellowish color. It was found that these uncontrolled reactions could be arrested easily and simply once their chemical nature was understood.



MOVING FREEZER PLATES

Fillets on plates of conveyor, freeze in about 35 to 40 minutes. Room temperature is well below zero

THE result of all these discoveries is fish flesh equal to fish just out of water, but able to endure in its original condition while it is being transported inland.

But to perfect such a fish for the modern home it is imperative to remove all waste parts (for the manufacture of by-products); to enclose the boneless edible flesh, after it passes through the automatic and continuous freezing process, in a sanitary package; to provide refrigerated transportation to distant cities; and to provide means for holding it frozen in the retail store until it is taken home by the consumer. Then if it is put into the oven still frozen, this is the assurance that it is still in prime condition.

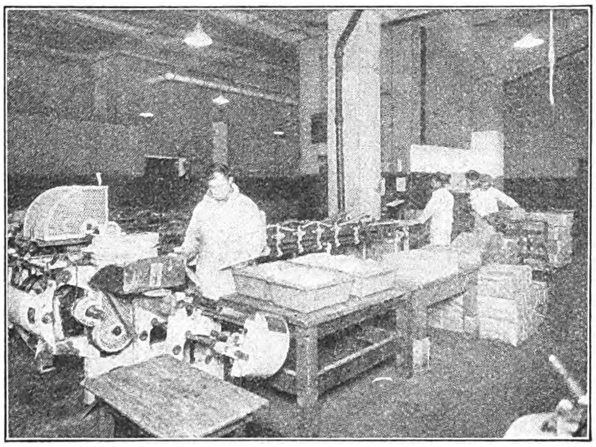
The chain of events from the bottom of the sea to the consumer's table is as follows: Fish (principally haddock) are taken from the Atlantic Ocean at Cape Cod by giant trawls, or funnel-shaped nets dragged by steel steamships or trawlers, and iced down until they arrive at port. From 100,000 to 250,000 pounds are brought in each trip. The fillets (clear strips of meat) are immediately cut, and frozen on an automatic, continuously-operating freezer, maintaining a temperature of 15 degrees to 25 degrees below zero, the fillets resting on aluminum plates. Each machine freezes 25,000 pounds, or a carload a day.

THE frozen fillets are now skinned and conveyed to automatic wrapping machines, each of which wraps 30 packages a minute in paraffin moisture-proof vegetable parchment. These individual packages, each containing one fillet, are packed in impervious containers and conveyed to a cold room where the temperature is near zero, Fahrenheit. From this room, cars are loaded.

The cars are an interesting feature of this system and are worth a few words of description here. The usual ice-and-salt refrigerator cars scarcely maintain sufficiently low temperatures in warm weather to carry the fillets frozen, hence a new car has been adopted.

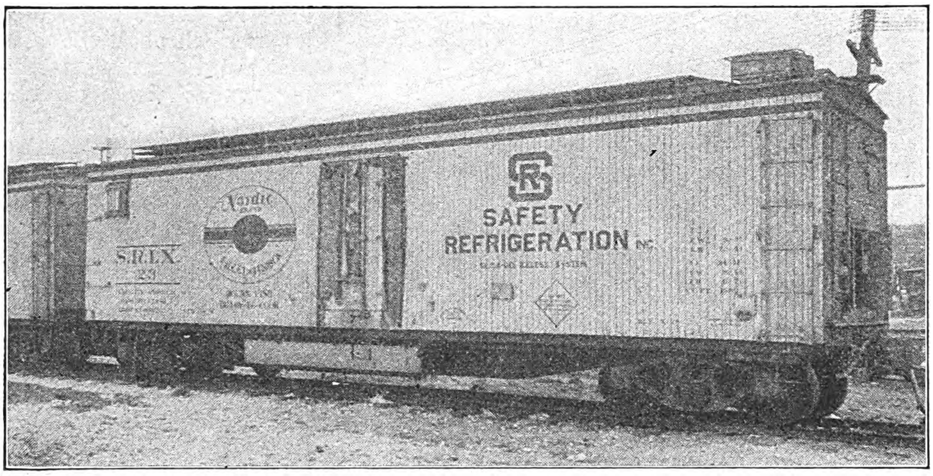
This car is refrigerated by an absorption system, in principle very similar to the familiar ammonia absorption system, but adapted for automatic operation on freight cars. Fuel gas liquified in a tank suspended under the frame of the cars is used for direct heating of the generators. A condenser is mounted on the roof. The cooling evaporator pipes are mounted lengthwise on the ceiling inside the car.

Instead of ammonia, sulfur dioxide gas is used as the refrigerant. This gas, being completely oxidized, is stable, and is not subject to the decomposition that occurs in ammonia. Non-condensible gas does not accumulate in sulfur dioxode. Sulfur dioxide also has the advantage of lower operating pressures than those of ammonia.



PREPARING FILLETS FOR SHIPMENT

Automatic wrapping machine wrapping fillets of fish after they are frozen. They are packed in paraffin paper and shipped in special refrigeratar cars



THE SILICA GEL REFRIGERATOR CAR

The new type of car in which frozen fish are shipped. No ice is necessary, since the car contains its own refrigerating equipment which is automatic and maintains a low temperature

In the ammonia absorption system, water is used as the absorbing medium. In the Silica Gel system, Silica Gel is used as the absorbing medium. This substance, being solid, cannot be pumped. The vessels in which it is contained are, therefore, alternately heated and cooled, serving as generators while they are being heated, and as absorbers while they are cooling.

SILICA GEL is a relatively new substance to industry. Chemically it is hydrated silicon dioxide. It is made from sodium silicate, or water-glass, by the addition of sulfuric acid. Upon the addition of the acid the silicate forms a jelly, sodium sulfate being formed simultaneously. This jelly is washed free of sodium sulfate, broken into pieces, and dried. The broken and dried Silica Gel is screened into pieces of uniform size, the granules having the appearance of broken glass or gum arabic. The most conspicuous property of Silica Gel is its marked absorbent property—or more properly, "adsorbent," the word used by physical chemists for this particular type of absorption. The Gel has an immense surface in the pores of its structure (ultra-microscopic in size) which gives it an amazing adsorbing power. It will adsorb 35 percent of its weight of sulfur dioxide gas, and give this gas off again when the Gel is heated, the Gel itself remaining physically and chemically unchanged throughout the cycle of adsorption and generation.

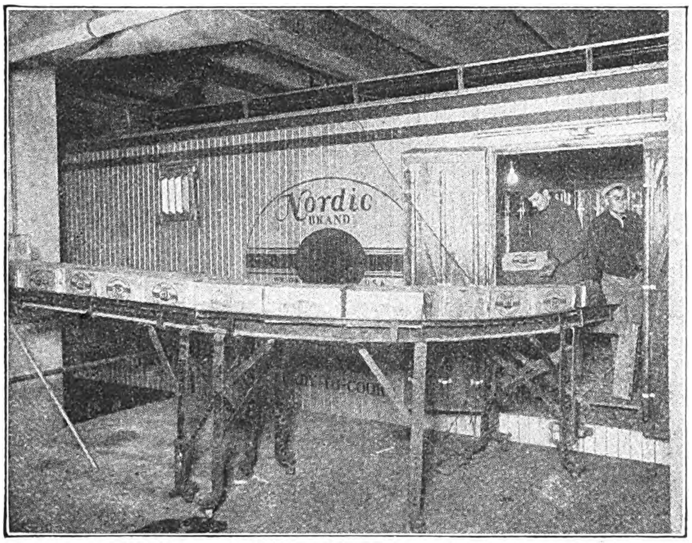
In the cars, the Silica Gel is contained in vertical steel tubes, 400 such tubes being one unit, and four units being used—two heated as generators and two being cooled as adsorbers at any particular time. When a saturated unit is being heated, a check valve cuts it off from the evaporator and another opens to the condenser.

These cars have been in operation several months and have operated perfectly. The temperature can be brought to zero, Fahrenheit. A fuel gas supply tank is located at the fillet plant at Groton, Connecticut. The tanks of the car are filled and the apparatus set going to pre-cool the cars which, upon being loaded, are sent out set for a temperature of 15 degrees to 20 degrees, Fahrenheit. These temperatures are maintained regularly on the entire trip. Numerous cars have been forwarded to points in Texas and other southern states with entire success and one has gone to San Francisco from Groton, Connecticut. Its temperature on arrival was 17 degrees, Fahrenheit. Another is at the time of this writing *en route* from Groton to Los Angeles, California.

Arriving at their destination, the boxes of frozen fillets are placed immediately in cold storage rooms at a few degrees above zero, Fahrenheit. From here, they are delivered by refrigerator trucks to retail stores. Electric refrigerators are being installed to hold the fillets in stores until they are sold. These refrigerators keep the fillets at from 15 degrees to 20 degrees, Fahrenheit. Solid carbon dioxide ("dry ice") is also being used to some extent for retail store refrigeration.

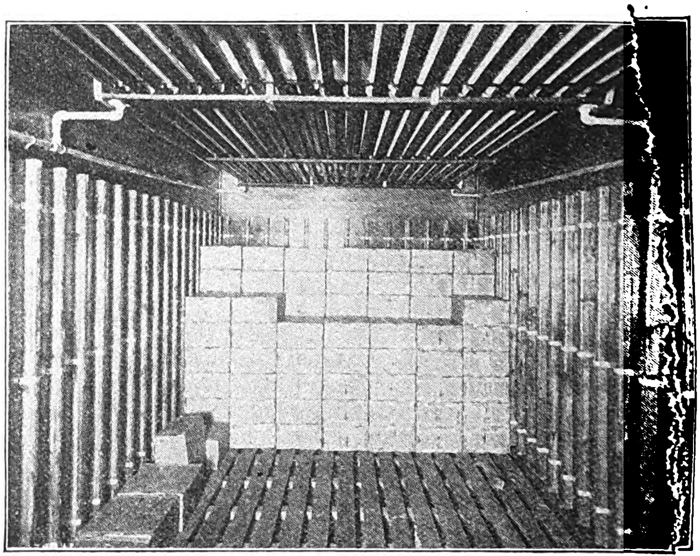
This system of preparation and distribution accomplishes its primary purpose of delivering fish at distant points in the same condition they were in when landed at port.

AS secondary advantages, it enables all grocery stores to sell fish without smell or mess. It enables them to stock fish all the time instead of Fridays only, without danger of loss. It assures a supply of fish in summer (when, of all times, fish is most suitable in the diet); it provides a clean, protected sanitary piece of sea food, which is 100 percent edible, and all at about the same price as would be paid for the edible portion of ordinary whole fish. This is made possible by utilization of waste for by-products, labor-saving machinery, carload freight instead of express shipment, and efficient mass production.



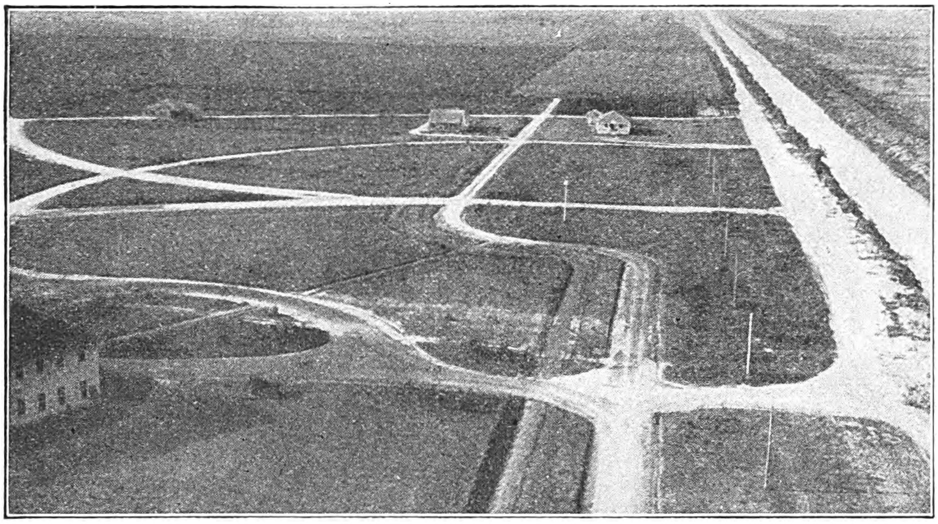
LOADING A CAR

Neat, dry packages of fillets being loaded into a Silica Gel refrigerator car. Shipments have been made over long distances



READY FOR COOKING

Fillets frozen and packed at the plant are shipped to the destination, and are kept in refrigerators until finally sold to consumer



NEW HOLLAND, A LAND OF CANALS

An airview of part of the drained district in North Carolina, showing the central canal, the layout of the town site of New Holland, the network of roads, and farms in the background

Drained Tract Is New World Netherlands

Lake and Land Below Sea Level In North Carolina Is Reclaimed For Farming

By G. S. CARRAWAY

THE success of what is said to be the largest drainage pumping plant in the world, located at New Holland in North Carolina, as proved last fall by the efficiency of the big pumps during record wet weather, is listed as one of the outstanding engineering and industrial events of the period.

This mammoth pumping plant has drained effectively 100,000 acres in eastern North Carolina, including 50,000 acres of Lake Mattamuskeet and 50,000 acres of adjoining territory. Where recently stood water and bullrushes are now thriving farm crops.

IN the lake site that was under water a few years ago, 4000 acres are now being cultivated successfully, with 5000 additional acres marked for cultivation by next fall. What is probably the largest soy-bean field in the world—covering 1400 acres—bears witness to the rapid progress made during the last three years on this great project.

Lake Mattamuskeet covered 48,000 acres of land a few years ago. It was shaped like a saucer, had no outlets, was three feet below sea level, and was six miles wide by 18 miles long. With no natural drainage, this large section of land was very marshy, but rainfall also caused much trouble, since as much as 60 inches often fell there in a year.

For 20 years various individuals and firms have been endeavoring to drain the land successfully so that it might be used for crops. Several companies failed; one being probably the first and only drainage company to go into a receivership. Some promoters drew monetary losses and prison terms for attempting to sell the land there on promises.

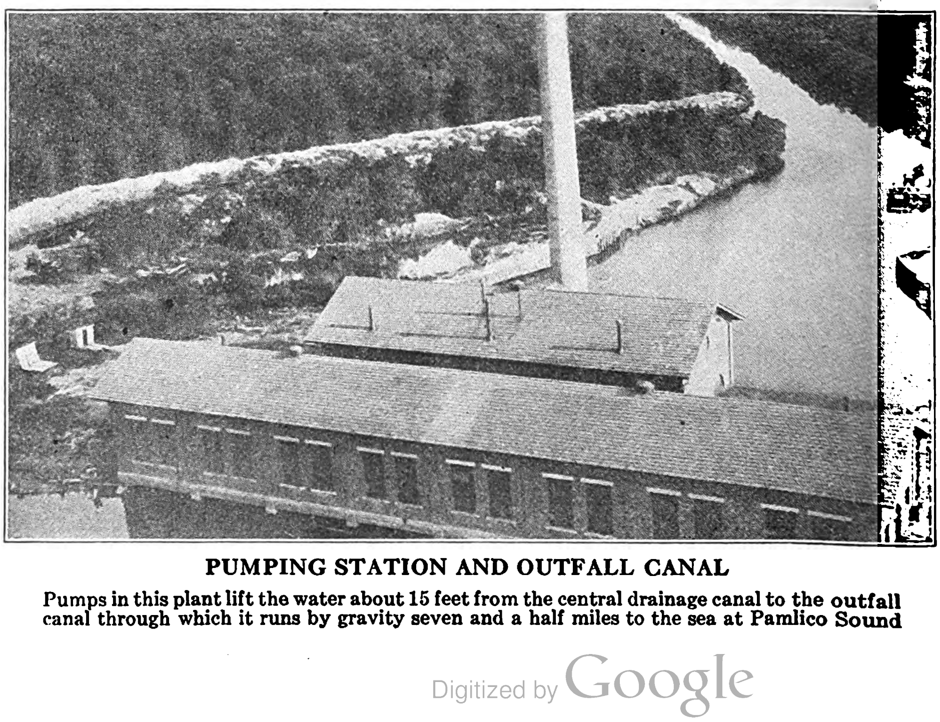
The New Holland Corporation was organized in 1925 by August Heckscher, millionaire real estate dealer of New York, who had decided to purchase the tract from the receivers and try to drain and develop it for farm crops. An investment of 1,500,000 dollars has been made by Mr. Heckscher in this development of which D. N. Graves, of Winchester, Massachusetts, is general manager, and B. M. Potter, of New Bern, North Carolina, is chief engineer.

Mr. Graves had been one of the first outsiders interested in the site. His way, however, was beset with difficulties and opposition. Doubters, knockers, and pessimists said that the work could not possibly be done successfully. Nevertheless, he worked tirelessly, supervising all phases of the vast and unusual work, heedless of opposition and unafraid of difficulties. For two years he kept five floating dredges at work. The sum of 365,000 dollars was spent in cleaning the old canals that had been dug by previous engineers.

WITHIN less than three years the land is being developed successfully and splendid crops have already been grown on part of the land. In addition to the 48,000 acres owned by the company, 51,000 acres of privately-owned land comes within the drainage district. Even the most pessimistic doubters are beginning now to admit the permanent success of the proposition.

The site is still the scene of great activity, as additional acres are being cleared and developed by the 500 or 600 men who are still working on the big area. Most of these workmen are employed in ditching. Records of all costs and results obtained are kept carefully. Operations are carried on both day and night, 27 tractors being equipped with headlights for night work.

Crop experiments were started in 1927 and excellent results obtained,



PUMPING STATION AND OUTFALL CANAL

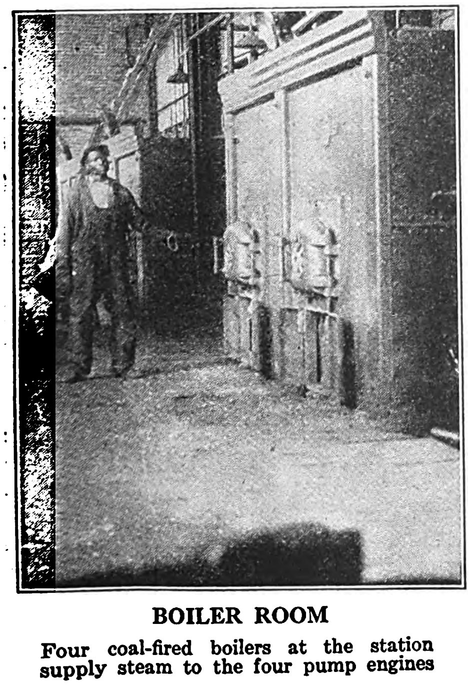
Pumps in this plant lift the water about 15 feet from the central drainage canal to the outfall canal through which it runs by gravity seven and a half miles to the sea at Pamlico Sound the following being examples: 50 bushels of soy beans to the acre, 960 bushels of sweet potatoes to the acre, and 35 bushels of wheat to the acre. The 1928 averages are even a little higher over wider ranges. Duroc hogs are raised successfully on the tract and much garden truck is grown by native New Hollanders. Two crops are planted annually on the same ground.

This unusual agricultural record is due to the success of the drainage pumping plant. A million gallons of water can be lifted and pumped each minute. There are four centrifugal Corliss engine steam pump units, each having a capacity of 250,000 gallons of water per minute. Eight miles of water barrels could be filled within one minute by these pumps, it is estimated.

USUALLY it is necessary to operate only one or perhaps two of the pump units, depending on the amount of rainfall and surface water, and it seldom is necessary for them to operate full time. All the canals on the big tract could be pumped dry, if desired, within a day. Four boilers, each of 3000 horsepower, are used. The unit cost for draining the entire district is said to be one dollar per acre each year.

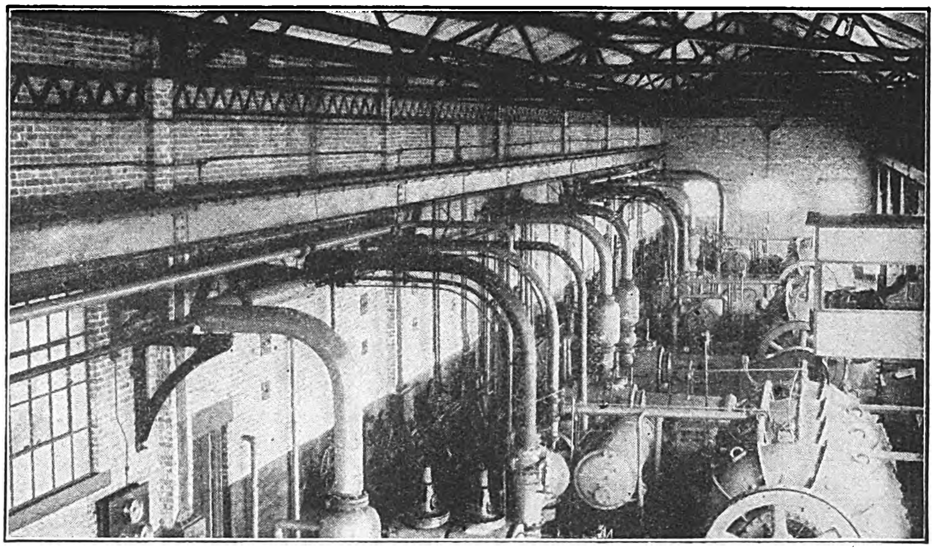
This system of drainage is accomplished by the use of culverts on the land, which drain to the ditches and canals. On every 1000 acres under development there are 50 miles of ditches. There are 100 miles of canals, one and a half miles apart, each from 20 to 100 feet wide.

The drained water is lifted almost 15 feet by the pumps and carried through big pipes in the plant to the outfall canal, which extends seven and a half miles to Pamlico Sound. The water thus flows by gravity down to the sea.



BOILER ROOM

Four coal-fired boilers at the station supply steam to the four pump engines



INTERIOR OF THE PUMPING PLANT

Four pumping units in this plant have a combined capacity of one million gallons of water a minute. They have proved capable of handling great floods during the wettest seasons

That the pumps are working successfully was proved during the summer and fall. A record rainfall of 27 inches fell during July, August, and September, 1928. Of this amount, 12 inches came during September. Despite this heavy rainfall, when other parts of the county stood many inches under water, the drainage site sustained no damage.

The development and town at New Holland are remarkably attractive. Plans for the place were drawn by a landscape gardener. Silver leaf poplars and other trees have been planted there in numbers, and shrubbery and flowers have been raised in profuse beauty during the last two years.

Where water stood a foot deep some years ago, there is now a picturesque inn, with a Dutch motif carried out in the decorations and equipment. Besides being a land of canals, the settlement actually bears a striking resemblance in other ways to old Holland, thus accounting for its name.

THE town has a water system, electric light plant, streets, and sewers. During the last year, 25 miles of roads have been constructed on the tract. A 35-mile railroad connects with outside railroads.

The project has cost much money but Mr. Heckscher is not interested in profits. Although he has visited the site only once, he is enthusiastic and eager to make the project unquestionably successful. That he has been able to obtain splendid results so far in a comparatively short time is evidenced by the fact that Florida drainage experts have visited the spot to study the methods of work at New Holland.

Such drainage schemes are expensive and difficult but they have some advantages over forest areas intended for agricultural purposes. There are no trees to be cut down or stumps to be dug; and the level, flat land and the deep, rich soil are easily adapted to quick machine cultivation. The 10-acre tracts may be rapidly ditched, bridged, drained, and connected by roads, and quickly put into proper condition for plowing and planting.

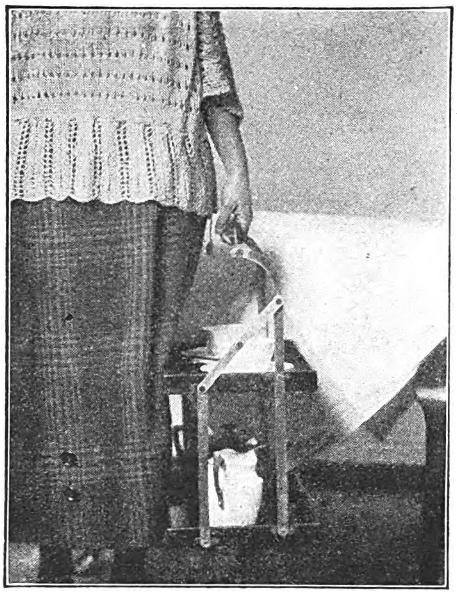
In the main part of the big drainage pumping plant is an inscription, written by the Mattamuskeet Drainage District Committee, which indicates the purposes and advantages of the mammoth, unique drainage scheme in North Carolina. It reads as follows:

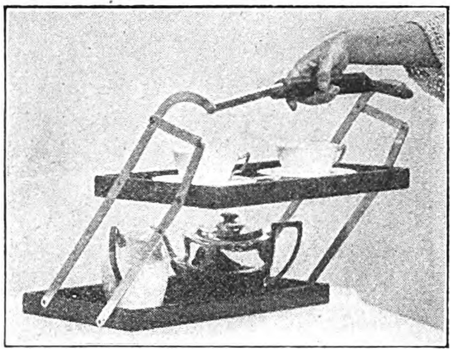
"THIS plant is dedicated to the spirit of co-operation, which has here transformed the great lake into dry land and so created a new and fertile principality for the use and possession of man.

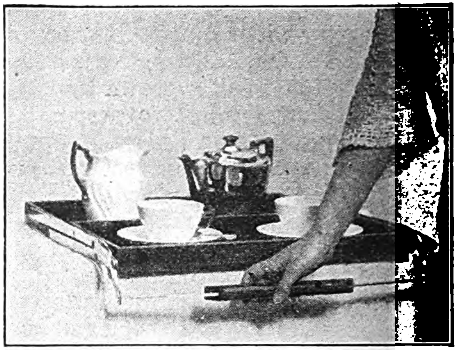
" 'And he gave it for his opinion that whoever could make two ears of corn or two blades of grass to grow upon a spot of ground where only one grew before would deserve better of mankind and do more essential service to his country than the whole race of politicians put together.' — *Daniel Defoe.*"

While the New Holland drainage project is perhaps the greatest unit system of its kind ever to be put into operation in this country, there are other immense tracts of swampy waste land throughout the United States where similar methods of reclamation might be used to great advantage. Notable among these is the area generally known as the "Jersey Meadows," many thousands of acres in extent, and now covered with bull-rushes. The Jersey Meadows are close to the center of the New York metropolitan area, are bordered by a rich industrial development, and lie along the Passaic River which runs between the west shore of the Hudson River and Newark, New Jersey, and its surrounding group of cities. Previous efforts to reclaim this land have been by filling.

Household Helps

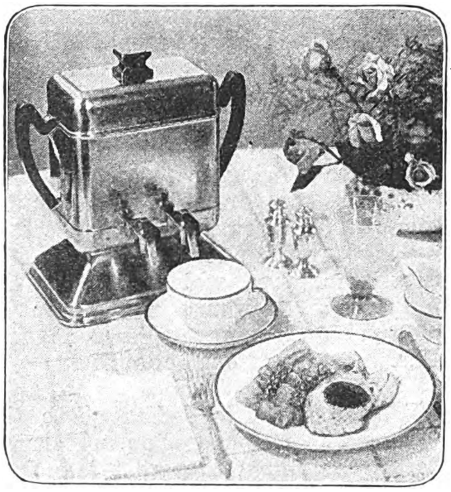






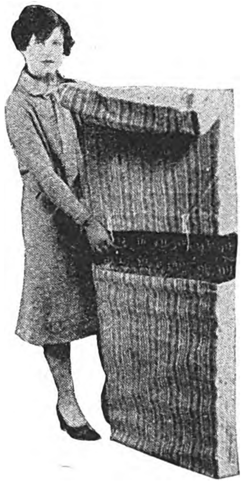
◄ ▲ FOLDING SERVICE TRAY CARRIED WITH ONE HAND ▲

An English manufacturer presents this collapsible folding tray, which folds flat on the table or can be converted into a two-tier tray by simply lifting the handle. It is light and well balanced, and designed to be carried with only one hand. *Besway Manufacturing Company, The Green, Stratford, London, E 15, England*



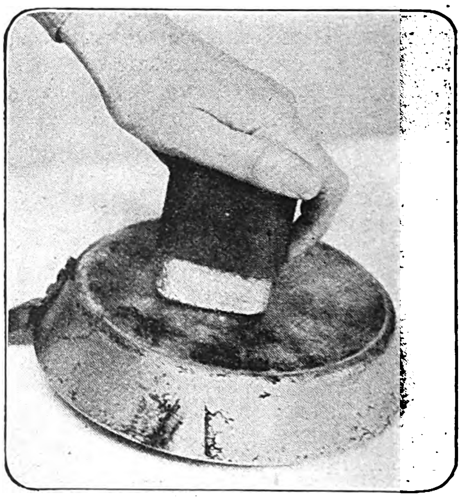
NEW COFFEE URN

This handsome little urn makes coffee without brewing it. It has two compartments and two faucets, one for hot water and the other for coffee. The water is electrically heated, syphoned over the coffee grounds, and then accumulated as coffee. *Thomas A. Edison, Inc., Orange, N. J.*



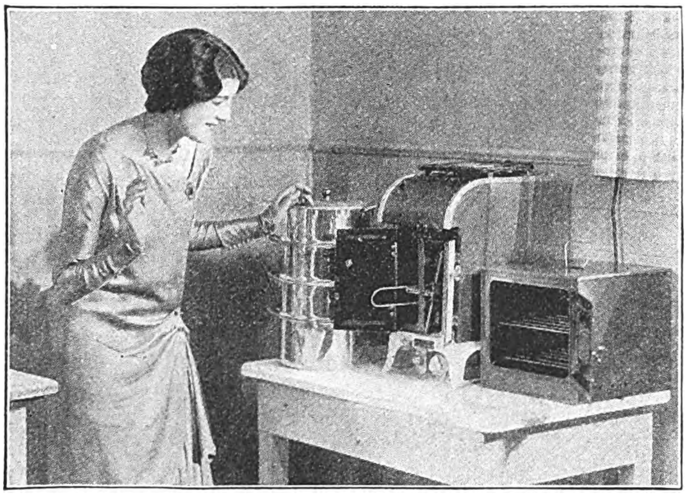
IMPROVED BED SPRINGS

Unusual construction makes it possible to roll and carry this combination mattress and bed spring. It is light in weight, and is so designed that the heavy cover can be removed with ease, whenever it is desired to wash it, or clean the springs. *The Karr Mfg. Company, Holland, Michigan*



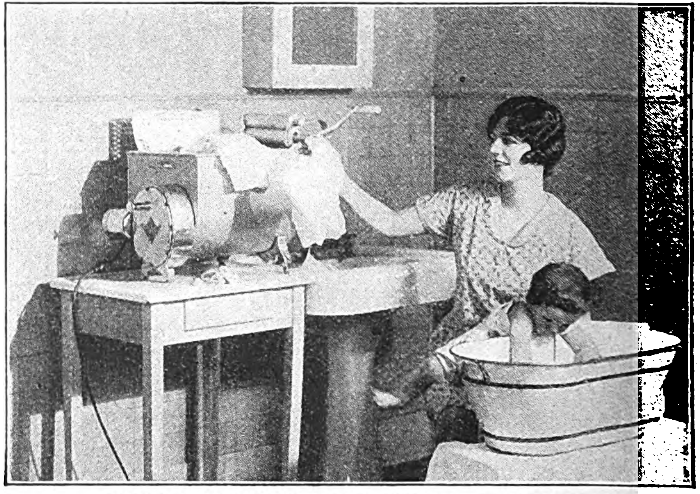
SCOURING DEVICE

This rubber covered steel-wool brush is designed to save wear and tear on the hands when scouring kitchen utensils. The steel wool contains a chemical designed to make it particularly effective for cleaning and polishing aluminum ware. *Whiskette, 3240 North 13 Street, Philadelphia, Penn.*



TASTY STEAKS WITH LESS SMOKE

In this electric broiler, the natural juices of meats of all kinds are sealed in tight, eliminating loss in flavor and weight in the drip pan, as well as the customary smoke. *Serelco, Incorporated, Graybar Building, New York City*



SMALL WASHER FOR SMALL FAMILIES

This little electric washing machine is designed for use in small homes or apartments. It weighs only 20 pounds and can be placed on any small table, or in the bathtub. *Handi Appliance Corporation, 11 West 42nd Street, New York, N. Y.*

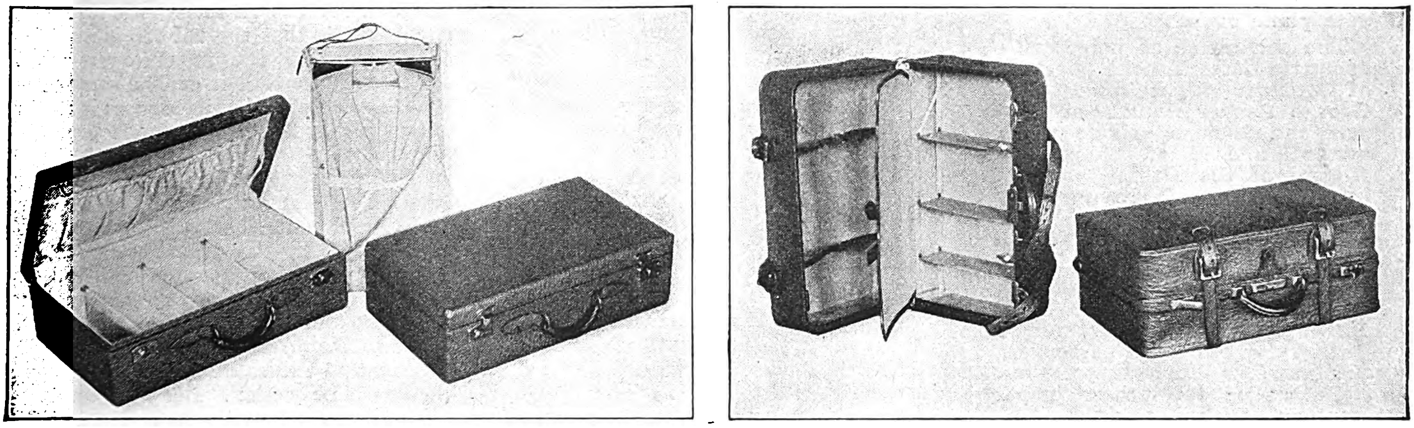
Inventions New and Interesting

◄ SINGLE-LEG TABLE

The comfort of your favorite easy chair can be enjoyed while using this table. It has just one leg, but when placed on an arm chair it is quite firm, and is adadjustable to the desired height.—*Solitaire Table Company, Old Saybrook, Conn.*

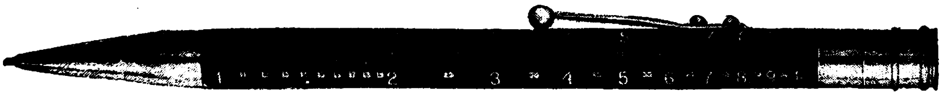
LAMP SWITCH AND LIGHTER ►

This cord has one switch to control the lamp and another to operate an attached cigar lighter. Arm chair addicts and those who like to read and smoke in bed will appreciate it.—*A. W. Franklin, Inc., 11 W. 42nd Street, New York*



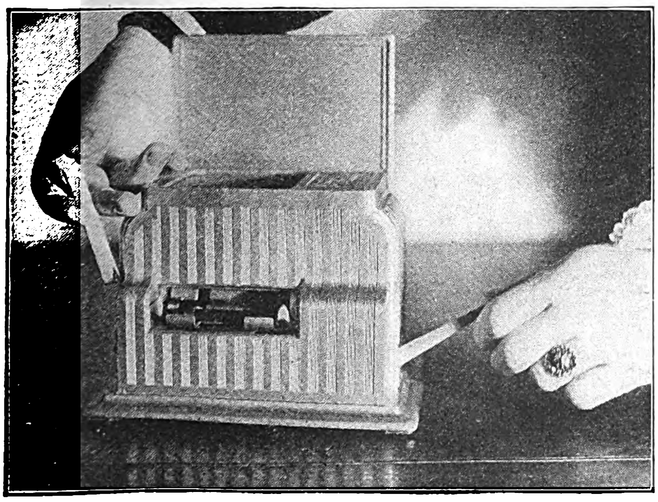
COLLAPSIBLE PARTITIONS DISTINGUISH NEW LUGGAGE

Keeping any semblance of order in old fashioned luggage is something of an art. These new bags make it easy to follow the old rule, "A place for everything, and everything in its place." The partitions can be folded flat when space is needed for large articles. By using the tray over the partitions, and the hangers and envelope, garments can be moved without fear of dust or wrinkles.—*Western Grip and Trunk Company, Milwaukee, Wisconsin*



SLIDE RULE COMBINED WITH MECHANICAL PENCIL

This mechanical pencil, made of metal-mounted Bakelite and slit so that the two segments slide longitudinally, combines a thin-lead pencil with an accurate and convenient slide rule.—*Ruxton Multi-Vider Corporation, Graybar Building, New York*



HUMIDOR LIGHTER

This addition to the smoker's equipment automatically presents a lighted cigarette, by just pressing a lever. When the lever is depressed, a cigarette drops into the opening at the front, and the lighter is ignited by the familiar "spark-wheel and flint" principle. When the lighted cigarette is removed, the lighter is extinguished.—*Blake-Clarke Company, 522 Fifth Avenue, New York City*

LETTERING KEYS

Amateur sign painters and others can lay out perfect letters and numerals with this tool.—*Consolidated Sign Letter Company, 73 West Van Buren Street, Chicago, Illinois*

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York City

Airplane Design Competition

We are very happy to announce that, thanks to the generosity of Colonel R. Potter Campbell of the American Cirrus Engines, Inc., a prize of $500 will be offered by the Scientific American for the best design of a light plane which is submitted before October 1, 1929; the design called for to be one which is specially adapted to the needs of the private plane owner.

The committee of judges will comprise Miss Amelia Earhart of Atlantic flight fame; Mr. George Palmer Putnam of Putnam and Sons, a private plane owner; and Prof. Alexander Klemin of the Daniel Guggenheim School of Aeronautics, New York University.

Competitors will be required to submit to the committee a description of their design and preliminary calculations with drawings illustrating accommodations for pilot and passenger, and drawings illustrating the installation of the power plant, together with drawings and sketches showing the general structure of the plane. Full particulars of the competition, together with data on the size and type of engine around which the plane is to be designed, will appear in the next issue of the Scientific American. The competition will be free to everyone in the United States, and it is believed that it will tap a wide source of design and engineering skill.

A New Type of Landing Field

GAVIN HADDEN, a New York engineer, has designed a new type of landing field which has some interesting features. For runways of a given length in all directions, a field in the shape of an equilateral triangle, with this runway length as its altitude, will occupy the smallest possible area of ground.

If instead of merely having equilateral triangle, the equilateral triangle is bounded by three circular arcs each described about an apex of the equilateral triangle, with radii equal to the side of the triangle, certain further advantages accrue. It is now possible to lay down runways of equal length in all directions. The drawing shows a 12-way system, with runways at uniform intervals of 30 degrees.

Mr. Hadden estimates that with runways 2500 feet long, this system would require about 18,000 square yards less than the familiar circular system of runways with all intersecting at the center. The saving is of course due to the 15 separate and complete intersections, where the paving of one runway serves for the runway of an intersecting runway. If a "triarc" landing field is placed within a square, it is possible to swing the landing area proper in such a way as to avoid topographically unfavorable sections of the terrain. It remains to be seen whether this theoretical conception will be followed in practice.

Dinghies for Flying Boats

THE British are a sea-going people and many picturesque sea terms are in common use with them, which rarely appear in American speech. "Dinghy" is one of these interesting words and it is certainly more striking than merely "small boat." Small boats of various kinds have been tried out on seaplanes by our own navy, but it is interesting to have the views of an English authority, Flight Lieutenant B. C. H. Cross, who discusses dinghies in part of a paper presented before the Royal Aeronautical Society. His opinion is that at the present stage of development, it is doubtful whether the additional load of a small boat can be justifiably added to the already overburdened seaplane. In practice the surplus carrying capacity which can be allotted to a dinghy is so restricted that it appears impracticable to build one suitable for operation in anything but the calmest water. If it is regarded as a raft for use in emergency and to replace the weight of flotation jackets for the crew, it would be hardly justified. Lieutenant Cross considers it more economical of weight to develop a combined floating and flying suit, or to utilize inflated cushions, in the case of a commercial service flying boat.

Since the design of such boats may engage the attention of American inventors and designers, it may be of interest to give the author's classification and comment on this specialized type of craft:

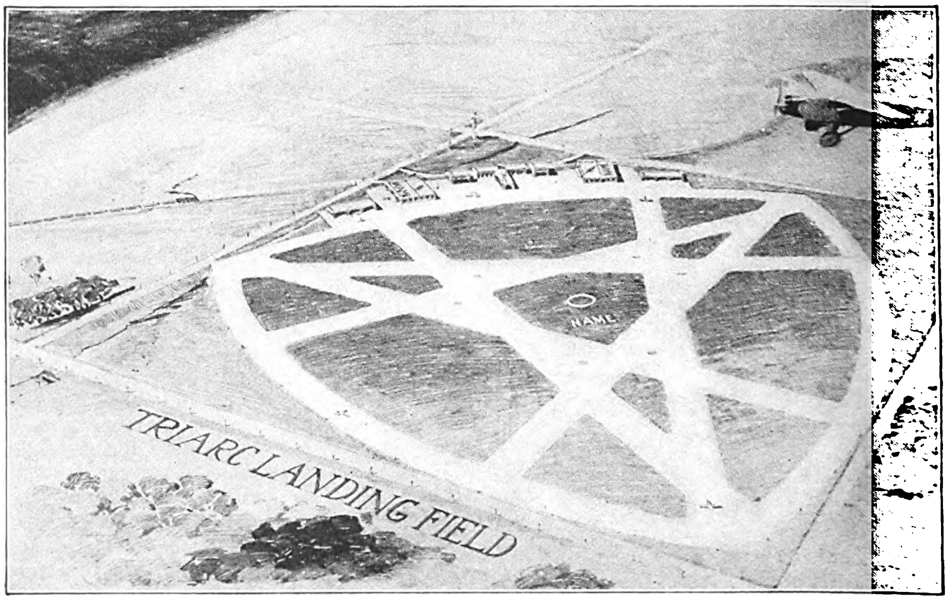
"Dinghies actually tested are of three types, which may be classified as inflatable, folding, and rigid.

"The inflatable type consists of an oval-shaped rubber raft, the periphery of which is of hollow rubber which can be blown up by a hand pump. The time taken to inflate may be ten minutes, but small cylinders containing carbon dioxide have been designed for use in emergency. Its disadvantage is that the rubber is too liable to damage for use in emergency. Its advantages are that it can be stowed into a small space and that as long as it remains unpunctured, it would support a crew of five or six.

"The folding type has many variations. It has been constructed with a light ash frame-work covered with canvas, and also combined with the inflatable type, and one of the most successful has consisted of thin wood with canvas hinges combined with a surround of floating material. This type has the advantage of being stowable inside a hull and can be assembled rapidly on the center section. But in emergencies it definitely relies on the amount of floating material in its construction for the buoyancy afforded to a crew.

"The rigid type has been built in both wood and metal, and provision has been made for attachment outside the hull. It relies on water-tight compartments for remaining afloat when flooded. It is the strongest of the dinghies used, rapidly available for use, but heavier than the other types."

It would seem on the whole that the small



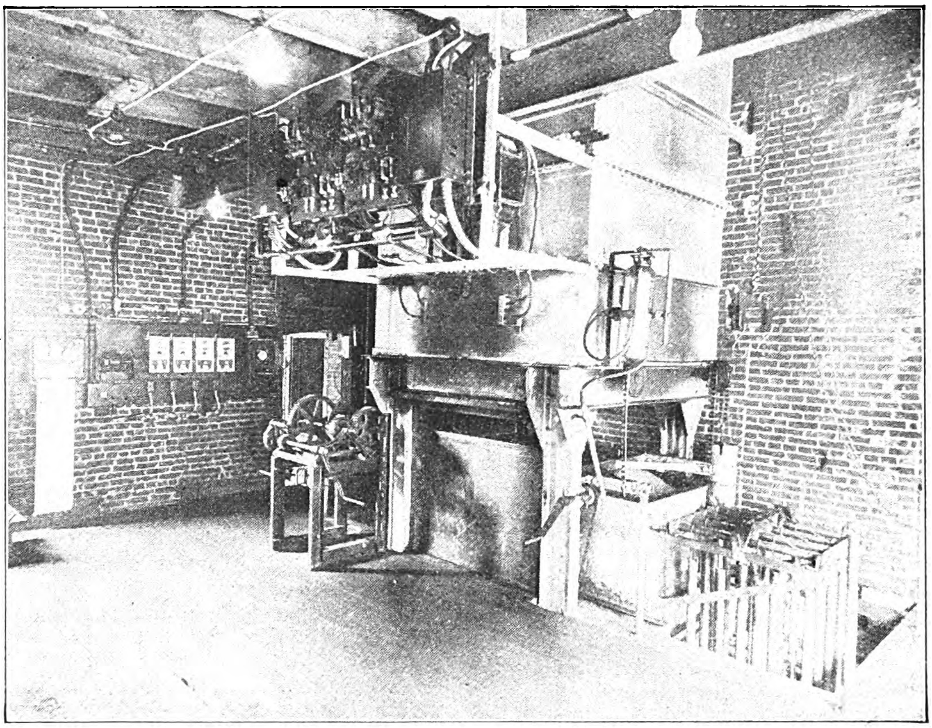
An artist's conception of the "triarc" landing field viewed from the air boat is an expensive luxury, and that it will only come into general use on very large flying boats.

Vertical Heat-Treating Furnace

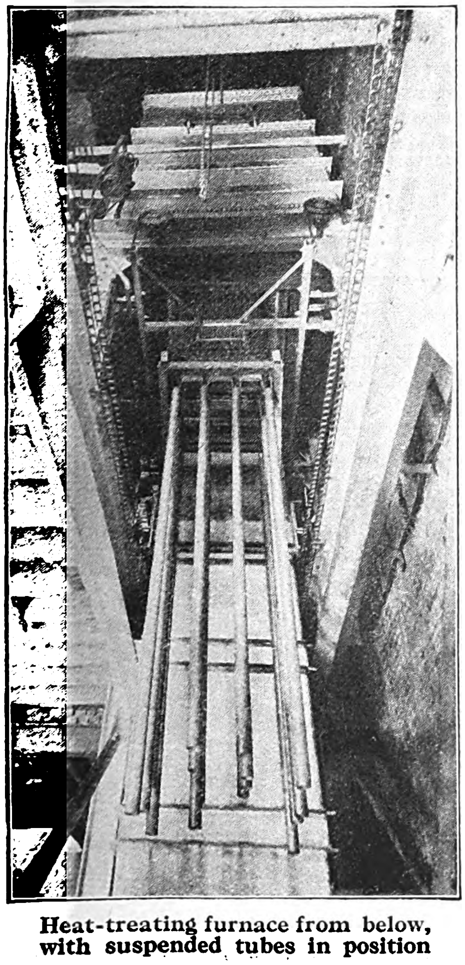
THE construction of airplanes is rapidly passing from wood to metal, either alloy steel or duralumin, and with both metals heat treatment is essential. In airplane construction, particularly as regards wing spars, much longer members are encountered than in automobile practice, and special heat-treatment furnaces have to be devised. With very long members the difficulty is two-fold; the member to be heat-treated must remain straight and the temperature at every point along its length must remain the same. Metallurgical Laboratories of Philadelphia have devised a new type of vertical furnace in which spars 10 feet long can be heat-treated, and a furnace under construction will be able to handle 25-foot lengths. The furnace is described in a recent issue of *Automotive Industries.*

The parts to be treated are suspended from a spider of chrome alloy by means of Nichrome hooks. Suspension takes care of keeping the tubes straight. To secure uniform temperature, the heating units are divided into four sections, mounted at different levels and each provided with its own automatic temperature control.

In one of our photographs, the four control units are shown mounted on the wall. These units operate control switches, mounted at the side of the furnace close to the ceiling, which cut the heating units in and out of the circuit as determined by the controller units. The other photograph shows some suspended members, as seen from below.



Temperature control system of the new furnace for treating airplane members. This is described in these columns, and another view appears below



Heat-treating furnace from below, with suspended tubes in position

The chamber of the furnace now operating is three square feet in cross-section and 10 feet long, and has a capacity of 400 pounds per hour. The quenching tank, together with a loading platform adjacent to it, is mounted on rollers and can be moved laterally with respect to the furnace by means of a hand crank. The furnace has a movable bottom which, being counterbalanced, can readily be lowered by hand, and can then be moved to one side so as to leave the opening of the furnace free for the introduction or removal of a charge. At the bottom of the quenching tank there is a drain or sump which has sufficient capacity to take the entire contents of the quenching tank. This is convenient when desiring to change from oil quenching to water quenching.

135 Passengers

ACCORDING to *London Airways*, Dr. Rumpler, the German constructor, is now building the largest flying boat yet attempted. It will be equipped with 10 engines and carry a crew of 35 with accommodations for 135 passengers in its wing. The flying boat will have two hulls, and the engines, fuel tanks, and passenger quarters will be distributed along the span of the wing. The theory of this distribution of the load is that bending moments on the wing will be diminished and its weight kept down in spite of the enormous dimensions of the craft.

An Aviation Ticket Office

AMERICAN aviation has often been reproached for lagging behind in passenger air-transport and for not bringing air travel within ready reach of the public. Both reproaches will soon cease to have any justification. Air Associates of New York City announce the establishment of a consolidated ticket office in their Fifth Avenue headquarters. This will enable a passenger to reserve a seat on any passenger-carrying line in the United States or Europe, or to arrange for chartering an aerial taxi. From New York City regular passenger services are, or soon will be, available which will take a passenger by air to Chicago, to the Pacific Coast, to Canada, and, in combination with rail service, to Havana.

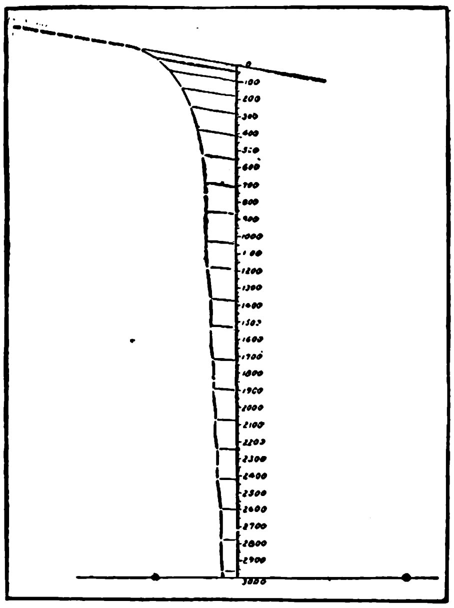
Aviation Law

CHESTER W. CUTHELL, President of the American Bar Association, is a distinguished attorney whose major professional interests lie in aviation. His views on the legal problems of aviation are therefore authoritative. In his paper before the International Civil Aeronautics Conference in Washington, Mr. Cuthell brought out some interesting points.

There is an interesting axiom which states that the individual who owns the surface of the ground owns all of the air space to the sky and to the center of the earth. Such an idea would reader trespass in flying inevitable and make commercial flying practically impossible. Fortunately there are some legal decisions already available which render this ancient maxim invalid. Thus, Judge C. Michael of the District Court of Minnesota has stated in a case: "The upper air is a natural heritage common to all of the people, and its reasonable use ought not to be hampered by an ancient artificial matter of law as is here invoked. To apply the rule as contended for, would render lawful air navigation impossible, because if the plaintiff may prevent flights over his land then every other landowner can do the same."

Mr. Cuthell urges that there should be uniformity between the Federal law in aviation and the laws and regulations of the various states. Flying makes even a huge country like the United States shrink to modest dimensions. It would be disastrous to have a variety of laws in states which by air are only a few hours apart.

Practice in Europe is almost invariably to adopt subsidies. In the United States, the word subsidy is abhorrent. Yet the railways in the early days received direct aid in the form of land grants. Sometimes a railway would receive land over a width of two miles adjacent to the rails. There are stories of railways which cut valuable timber for ten miles on either side of their lines. Mr. Cuthell points out that our government has rightly avoided subsidies, because the distinguishing characteristic of the American has been his individual initiative and our government very properly is loath to destroy that initiative by the grant of sums of money to selected groups.



Path of dummy dropped from speeding plane. See text at right and other explanatory drawing below

"Nevertheless," said Mr. Cuthell, "our government has rendered very substantial aid to the business by encouraging the carriage of mail by public contract held by private companies. It has also aided indirectly in the establishment of airways and the incidental emergency fields, lighting equipment and weather reporting service. It undertakes also the inspection and examination of planes and pilots. In extending these aids it is doing nothing more than it has done in establishing lighthouses, buoys, boiler inspection, and examination of pilots in connection with ship operations, and in the point of money expended, the assistance thus rendered is far less than the assistance rendered to the automobile manufacturers and bus operators in the form of the systems of the modern highways."

Other legal problems which yet remain to be solved, are the liability of the owner of aircraft to the passengers carried, and limiting the use of aircraft in its present stage of development to those individuals who have been thoroughly trained by competent teachers. While there is keen rivalry among aviation manufacturers and operators, there has been little litigation. Lawyers are therefore free to concentrate on action which has the general good of the country as its objective.

While writing this abstract of Mr. Cuthell's valuable paper, we have received a valuable text "Aircraft Law Made Plain," by George B. Logan, published by the Van Hoffman Press, St. Louis. Written especially for those interested in aviation, such as prospective craft owners, operators, investors, and students, it avoids all difficult legal verbiage and makes matters clear and simple for the layman. A few items from the table of contents will furnish a trustworthy guide to the material presented: "Where may I fly? Who may regulate me or my plane? What are my liabilities? What effect will riding in or operating an airplane have on my insurance? Where will cases be tried arising out of air crimes, air-made contracts, wills, marriages, etc?"

Studying Parachute Jumps

LIEUTENANT A. G. FOULK, writing in *U. S. Air Services*, reports some very interesting studies of parachute jumps made by members of the Army Air Corps. Many questions of vital importance to parachute designers have now been solved. How far and how rapidly will a man drop in a given number of seconds? What is his limiting velocity? If the opening of the parachute is long delayed will the man become unconscious? Will the shock of opening, when long delayed, burst the 'chute? What is the minimum height from which a parachute jump is safe?

A simple, yet ingenious method of study was adopted. The tests were conducted at night. The apparatus consisted of an ordinary view camera, a shutter timing device, and a dummy equipped with a magnesium flare. The camera shutter was so arranged that it remained open except when snapped shut momentarily at one second intervals by means of an electric solenoid. A pendulum making one swing per second and coming in contact with a bubble of mercury at the bottom of each swing, served as a timer.

The airplane flew at a known altitude, and followed as nearly as possible a course perpendicular to a vertical plane through the axis of the camera, which was horizontal. When the dummy fell with its blazing flare, its path was recorded on the film as a series of dashes, the length of the dashes being proportional to the distance covered by the dummy during the corresponding one-second intervals. The photograph obtained in this manner, with a suitable reference scale, gave the plot of distance traveled against time. From this the velocity of the dummy at any instant could be readily deduced. The dummy weighed 180 pounds, and was constructed with dummy parachute pack so as to simulate a man.

Starting at 3000 feet, from a plane traveling horizontally at 80 miles per hour, it took the dummy nearly 21 seconds to reach the ground.

The limiting velocity of the dummy was about 120 miles per hour. As soon as the dummy picked up speed, the air resistance increased until it became equal to the weight of a man. Beyond this point there could be no further acceleration.

The chances of a man becoming unconscious if the opening of the 'chute is long delayed are therefore negligible. While 120 miles per hour is a high speed, any aviator in an open cockpit can withstand a blast of 120 miles per hour without much discomfort.

For similar reasons, there is not much chance of the parachute bursting because of delay in opening. In fact, if a man jumped from a plane diving at 200 miles per hour, as might well be the case if the wings had come off, his speed in the air would actually diminish; he would lag behind the falling plane.

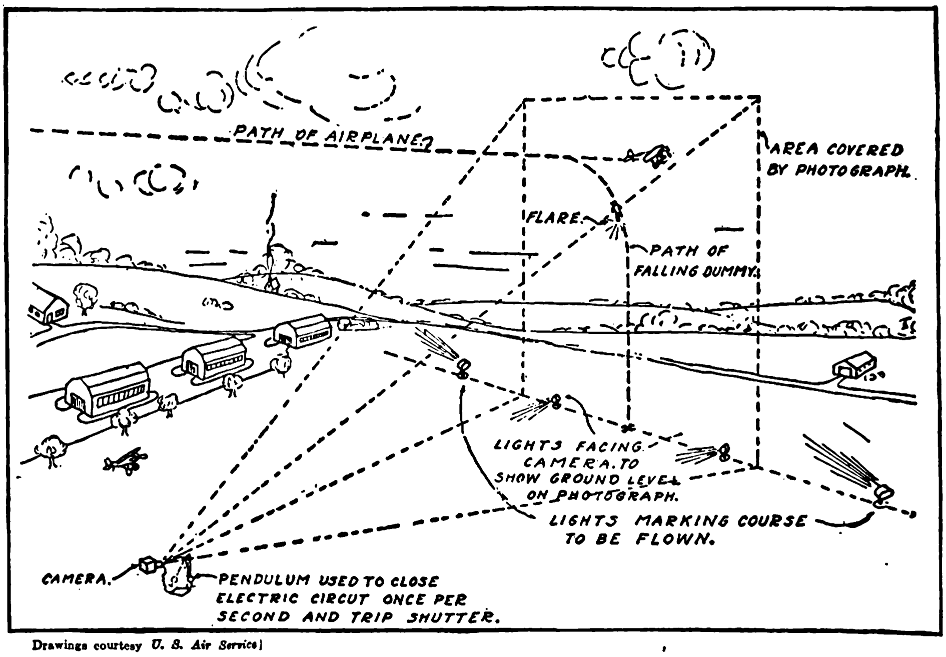
With plenty of altitude there is apparently no reason for a hurried pulling of the rip cord. The only reason for hurry is a psychological one; jumping through space, one would like to make sure as soon as possible that the parachute is actually going to function.

The question of minimum height from which a parachute jump can be safely made was not answered definitely even by these experiments.

Starting from a plane having a horizontal velocity of 80 miles per hour, the dummy dropped 175 feet in three seconds. Since it takes a parachute three seconds to inflate, a height of 175 feet would have been the barest minimum for a safe jump under these conditions.

If the plane had been flying more rapidly in a horizontal direction, the inflation would be speedier and in such a case the jump would become safe at something under 175 feet.

With a plane flying slowly, near the stalling speed, the rapidity of inflation would be less, and the height required would be greater.


PATH OF AIRPLANE
AREA COVERED BY PHOTOGRAPH.
FLARE
PATH OF FALLING DUMMY
LIGHTS FACING CAMERA TO SHOW GROUND LEVEL ON PHOTOGRAPH.
LIGHTS MARKING COURSE TO BE FLOWN.
CAMERA.
PENDULUM USED TO CLOSE ELECTRIC CIRCUIT ONCE PER SECOND AND TRIP SHUTTER.

Drawings courtesy *U. S. Air Service*

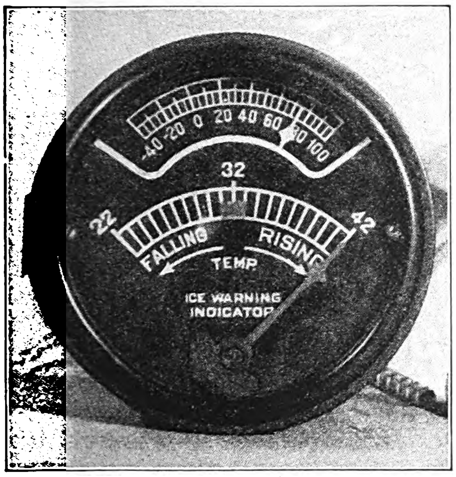
Diagram of the apparatus used to investigate the fall of a dummy from an airplane. The results of these tests indicate the relative value of parachutes

In a plane diving towards the ground at the instant of the jump a far greater height would be necessary.

While not every question is yet answered regarding jumps, our knowledge is accumulating to the point where a pilot will know with reasonable accuracy what he may and what he may not do.

An Ice-Warning Indicator

THE formation of ice on the wings still remains one of the greatest hazards of flying. So far all methods of combating such ice formation have proved unsuccessful. The best plan is to provide the airman with such weather service as will enable him to avoid flying under conditions likely to lead to ice formation, and to instruct pilots carefully as to what to do when there are signs of ice such as glide down to lower and warmer altitudes, for example. The Boyce Motometer Company of Long Island City has developed an ice-warning indicator which may be useful. The indicator is similar in principle to the strut thermometers often used on Army planes. The bulb of the thermometer is filled completely with Zylene under pressure. Any application of heat or cold at the bulb causes the entire column of liquid to expand or contract. The bulb is connected by a fine capillary tube to a Bourdon spring, which coils or uncoils as the liquid contracts or expands. The movement of the Bourdon spring moves a pointer across a dial mounted in the pilot's cockpit. On the upper scale of the dial, there are graduations from 40 to 100 degrees, Fahrenheit. Mounted below the mechanism described is a secondary movement similar to that employed in the ordinary type of pressure gage. When the pointer on the upper scale comes down to 42, a pin engages this secondary movement and the pointer on the lower scale is brought into use, giving a clear indication over an enlarged scale in the cold danger zone.



Special thermometer designed to warn of impending ice formation

Future of the Air Mail

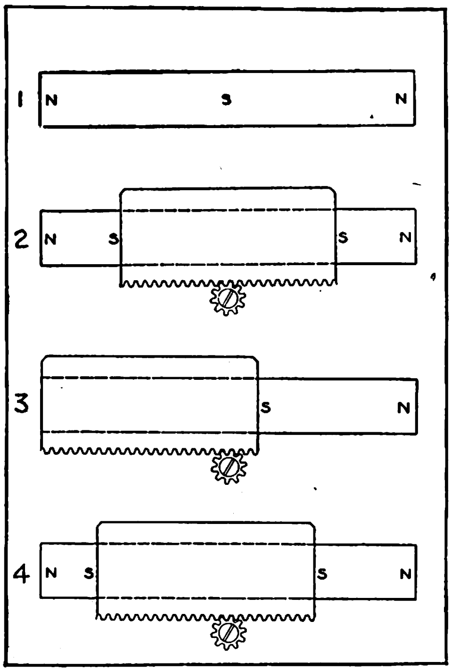
WILLIAM IRVING GLOVER, Assistant Postmaster General, writing in *Popular Aviation*, makes some startling yet well founded prophecies regarding the future of the air mail. Already 65,000,000 persons or more than half the population of the country are direct beneficiaries of the air-mail system. Within two years, Mr. Glover predicts, every city with a population of 50,000 will have direct access to an air-mail route. There will be large volumes of night mail transported by air.

The air post office clerk will sort these letters while flying through the air at 100 miles an hour or more. To accommodate the larger amount of mail carried, and to provide suitable working quarters for this new type of post office clerk, large and specially designed planes will be necessary. Airplane manufacturers and designers have already given much thought to the new designs that will be required. The railway companies will lose a certain amount of revenue, and the far-sighted railway companies may therefore seek alliances with the air transport companies. In fact they have already done so in three or four cases.

Planes of the future, Mr. Glover thinks, will carry 5000 pounds of postal matter. When the air mail started, the DH4 planes put in service had a maximum capacity of 500 pounds. With the five cent air-mail stamp in use, there are now being carried 300,000 letters daily. There is also an increasing business in packages, weighing one, two, or three pounds. Manufacturers of eye-glass lenses, film makers, manufacturers of small medical instruments, and wholesale chemists, are prominent among the patrons of this service.

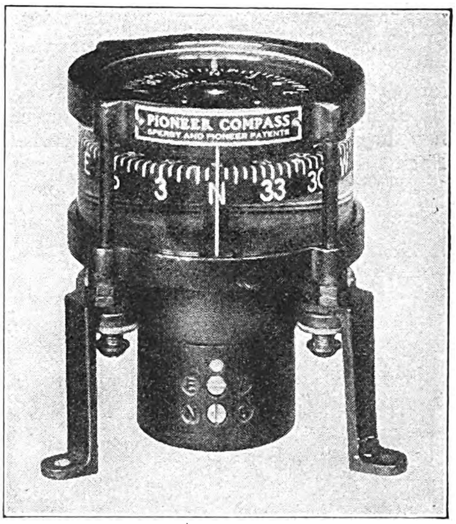
A Novel Compass Compensator

NO matter how well adjusted an airplane magnetic compass may be, it will read incorrectly when placed in the airplane. This is due to the presence of iron or steel employed in the construction of the airplane, which may be magnetized to such a degree as to change the compass readings from normal. Loose magnets have been employed hitherto to correct these discrepancies, some placed in line with the axis of the airplane, some athwartship. The loose magnets furnish a somewhat erratic means of compensation for magnetic disturbances, but the Titterington Micrometer Compensator produces an accurate method of correction.



This diagram shows how the compass compensator works. Numbers at the left are refered to in text

The compensator is based on an entirely novel principle. The basis of the compensator is a permanent magnet with north poles at each end and a south pole at the center as shown in the drawing. The effective external field of this magnet is zero, as it is the equivalent of two magnets which just balance each other. Around this special double magnet is a soft iron tube, half the length of the magnet, which acts as a magnetic shield. When placed in the middle of the magnet, 2, the tube shields one half of each end of the magnet, leaving the effective external field still at zero. By turning a screw, which is geared to the tube, the shielding tube can be moved to one end of the magnet or the other, 3. The tube can be thus made to shield either half of the double magnet, leaving the external field of the other half fully effective, the result being a N-S magnet of maximum strength. Stopping the tube at any intermediate point, shields each end partially and leaves an effective external field of reduced strength.



An airplane compass equipped with the new compensator described in these columns. Adjusting screws are on lower cylinder

The compensator as used on the typical magnetic compass contains two such center-pole magnets, one (the upper) being fore-and-aft, and the other (the lower) being athwartship.

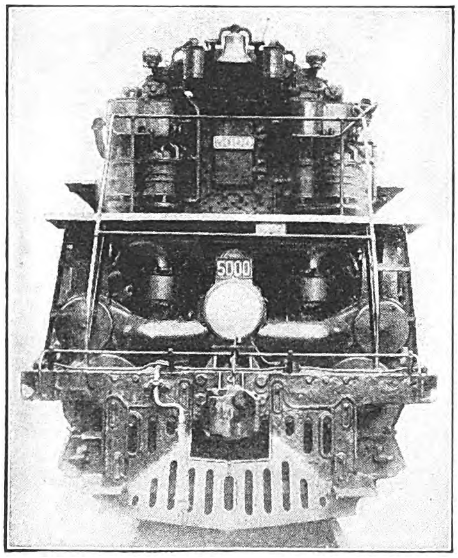
To compensate a compass, the following simple method is followed. The direction is determined by means of a magnetic compass suspended from a wing tip. The ship is headed toward the magnetic north pole. If the ship's compass does not read N, the lower compensator screw is turned until the compass does read N. A special non-magnetic screw driver should be employed. Next the airplane is headed due west. If the compass does not read west, the upper compensator screw is turned until the compass does read W. Next the airplane is headed due south. If the compass does not read S, the lower compensator screw is turned to take out half the error. The same process is repeated heading the airplane due east. When errors have been eliminated in this fashion as ar as possible, the airplane is swung successively N, 330, 300; W, 240, 210; S, 150, 120; E, 60 and 30 degrees, and the compass indication is noted on each heading on a correction chart. One of the first duties of a pilot who is to undertake long cross-country flights is to learn how to compensate his compass in this fashion.

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

World's Largest Steam Locomotive

THE largest steam locomotive in the world, which measures nearly half the length of an ordinary city block and three times the length of a standard freight car, has been constructed for the Northern Pacific Railway.



Note the location of the bell and headlight on this new monster of the rails, the giant locomotive of the Northern Pacific Railroad

This leviathan of the rails, which is 125 feet long, was shipped recently by the American Locomotive Company from its plant at Schenectady, New York, to H. H. Stevens, vice president in charge of operation on the Northern Pacific. It is experimental and is of the four-cylinder simple Mallet type.

The enormous proportions of this locomotive, which will ride the rails on 34 wheels, including 12 on the tender, were conceived by its designers and builders with a view to burning semi-bituminous coal, of comparatively low heating value, which is obtained from an open pit mine in the Rosebud coal field in southeastern Montana, operated by the Northern Pacific.

Other features of this super-locomotive are:

In working order, with coal and water, it weighs 1,116,000 pounds.

Its height from the top of the rail is 16 feet, four inches.

It has a normal tractive power of 140,000 pounds and a total tractive power of 153,400 pounds, including the trailer type booster, with which the engine is equipped.

The firebox, which is built to provide the greatest heating surface for burning the semi-bituminous coal, is equipped with five thermic syphons, three of which are in the firebox and two in the combustion chamber; the firebox, including the combustion chamber, is 28 feet, six inches long by nine feet, six inches wide; the grate is 19 feet, two inches long by nine feet, six inches wide, making a total of 182 square feet of grate area.

It has a mechanical stoker, which is of special design and is capable of crushing, delivering, and distributing to the firebox hourly a maximum of 45,000 pounds, or 22½ tons of coal.

Its tender has a capacity of 22,000 gallons of water and 27 tons of coal.

Water is supplied from the tender to the feed water heater and thence to the boiler by two centrifugal pumps. The engine is equipped with all of the most modern devices for efficient and safe operation, including automatic train stop.

This giant locomotive, according to operating officials of the railroad, will be placed in regular freight service between Glendive, Montana, and Mandan, North Dakota. The territory over which it will operate is of undulating profile, with controlling grades of 1 percent so separated over the territory that it is impracticable to establish helper or pusher districts. Up to now, over this section, it has been necessary to handle in two trains the tonnage which is carried in one train both west of Glendive and east of Mandan. This powerful new locomotive has capacity to pull between Glendive and Mandan in one train the same tonnage that is handled east and west of this 216-mile stretch where it will be in service.

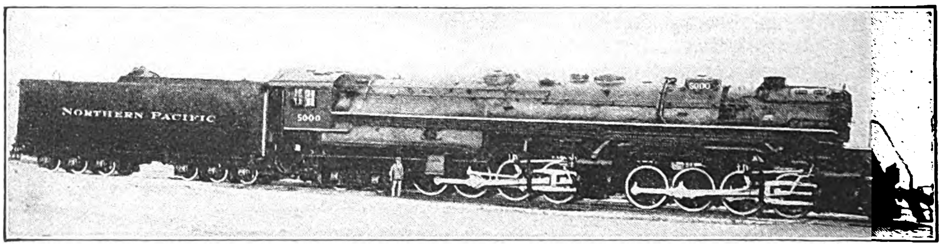
Britain Plants for New Forests

GREAT BRITAIN is planting new trees at the rate of 1,000,000 a week, according to information reaching the United States Department of Agriculture.

Before the war, the British government estimated that there were about 3,000,000,000 feet of standing timber in the British Isles, while today it is estimated that the timber resources have been reduced to half that amount.—*Science Service.*

Wilkins Returns From Antarctica

AT THE time this is being written, Captain Sir Hubert Wilkins is making preparations to leave his base on Deception Island in the antarctic where, for the past



The world's largest locomotive which does the work of two older ones

The SCIENTIFIC AMERICAN Sea Safety Gold Medal Committee of Judges

IN announcing, in January, the SCIENTIFIC AMERICAN Gold Medal for 1929 to be awarded for the device or apparatus most conducive to safety at sea, we stated that the American Museum of Safety, under whose supervision the medal will be, would select the Board of Judges at once and that we would announce the names of the men on this board in this issue. Since this board is not quite complete, we can list only those who have already agreed to serve. They are:

Rear Admiral C. McR. Winslow, U. S. N. (Ret.) Chairman
Rear Admiral Charles P. Plunkett, U. S. N. (Ret.)
Rear-Admiral W. S. Benson, U. S. N. (Ret.)
Captain Charles A. McAllister, American Bureau of Shipping
Captain Felix Riesenberg, Martin Motors, Inc.
Captain T. H. Lyon, International Mercantile Marine Company
Mr. H. H. Brown, Editor, *Marine Engineering and Shipping Age*
Captain Henry McConkey, Port Superintendent, Cunard Line
Captain E. T. Fitzgerald
Mr. Louis Weickum, Hamburg-American Line
Mr. A. B. Newell, Editorial Staff, *Motorship*

It is expected that the board will be complete within a few days, the first meeting held and the rules drawn up; and we shall, doubtless, be able to give all details pertaining to the competition in our April issue. In the meantime, we are happy to say, many letters approving our encouragement of sea safety are being received by us and by the American Museum of Safety each day. Already several entries have been made in the competition and others are expected immediately.

few months, he has been making explorations by airplane over hitherto unknown land. He has just completed the first phase of his explorations and has announced by radio his intention of returning to America to prepare for the second phase which will be carried on next year from a different base.

Prior to making this announcement, Wilkins had made a flight over Graham Land seeking a suitable base from which he could continue his explorations farther south, but was unsuccessful.

The *New York American* analyses the situation as follows:

"The Wilkins-Hearst Antarctic Expedition had two major objectives: First, exploration of Graham Land and the western coast of Weddell Sea by airplane; and second, a flight from Graham Land to Ross Sea and further exploration from a base established there.

"In flights from Deception Island over Graham Land, Captain Wilkins and his associates have accomplished the first objective and thereby solved the greatest problem that has confronted scientists and geographers in the antarctic.

"Graham Land is pictured on the maps as part of the Antarctic continent. Flying 1200 miles over land never before seen by human eyes in company with Pilot Ben Eielson on December 20, Wilkins discovered that Graham Land consists of two main islands and that the southernmost is separated from the Antarctic continent by a body of water 40 to 50 miles wide, lying between the 70th and 71st parallels south and longitude 60 and 70 west. This he has since named Stefansson Strait.

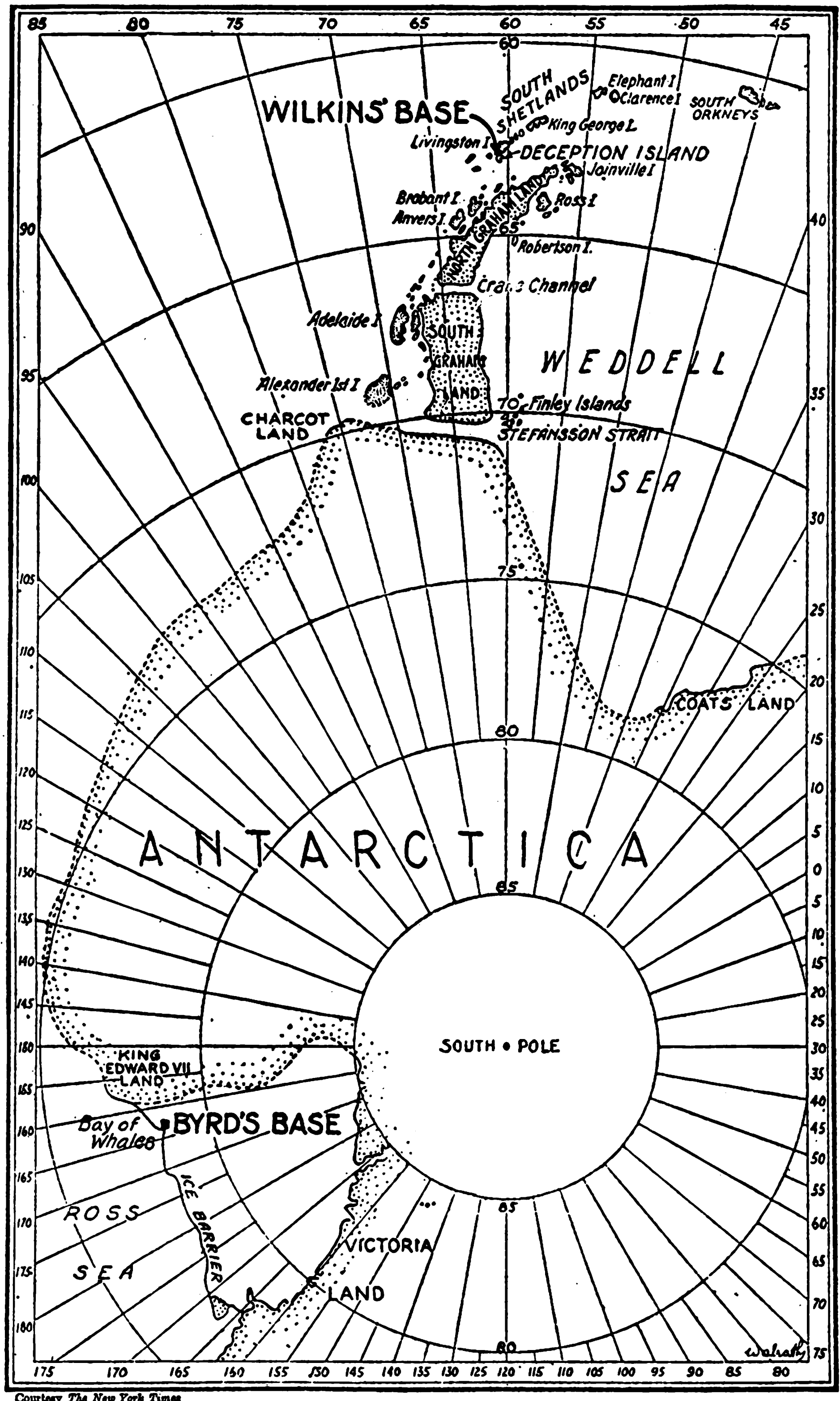
"The northern island has been renamed North Graham Island, and the southern, South Graham Island, the two being separated by a narrow, crooked strait.

"On the 65th parallel south, or within 100 miles of the Anarctic Circle, Wilkins found the coast of North Graham Island cut by indentations so deep that they almost met, threatening to sever it into still another island. These indentations he named the Hektoria Fiords.

"A group of six islands discovered southeast of South Graham Island he has named Finley Islands, in honor of Dr. J. H. Finley, president of the American Geographical Society, which sponsored the expedition.

"Captain Wilkins established what he believes to be the true edge of the Antarctic continent on approximately the 70th parallel south. This he has named Hearst Land, in honor of William Randolph Hearst, by whom the expedition was largely financed.

"One portion of the South Graham Island coast, Captain Wilkins designated as Bowman Coast, in honor of Dr. Isaiah Bowman, director of the American Geographical Society. Various mountains, plateaus, glaciers, and other geographical features were named for different persons whom Wilkins desired to honor."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WILKINS' BASE
SOUTH SHETLANDS
Elephant I
Clarence I
SOUTH ORKNEYS
King George I.
Livingston I.
DECEPTION ISLAND
Joinville I
Brabant I.
Anvers I.
NORTH GRAHAM LAND
Ross I
65
Robertson I.
Crane Channel
Adelaide I.
SOUTH GRAHAM LAND
WEDDELL SEA
Alexander Ist I
70
Finley Islands
CHARCOT LAND
STEFANSSON STRAIT
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COATS LAND
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ANTARCTICA
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SOUTH • POLE
KING EDWARD VII LAND
Bay of Whales
BYRD'S BASE
ROSS SEA
ICE BARRIER
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Courtesy *The New York Times*

Map showing Wilkins' base on the Antarctic Continent. Graham Land, formerly thought to be part of the continent, was found to be two islands

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Dogs Given Immunity to Distemper

A MEANS of protecting dogs against distemper, the canine "flu," has been found, although their human masters have still no sure means of protecting themselves against influenza, the disease which recently caused considerable alarm in the United States. The method of immunizing dogs against distemper has just been made public in a report by the Distemper Research Committee to the Medical Research Council and the Distemper Council of *Field*, a London magazine. The method, which is an inoculation, has been developed by Dr. P. P. Laidlaw and G. W. Dunkin. Inoculation and vaccination have been tried as a means of preventing influenza among humans, but so far have been unsuccessful.

The method consists of a double inoculation. The first inoculation is made with a vaccine which is, in fact, the inactivated virus of distemper. The second is made, after an interval of about 10 days, with an attenuated strain of living virus. The dose of living virus is a hundredfold that which would infect a dog not previously treated with the vaccine, but as a rule it is followed by nothing more than a trivial and transient disturbance of health; often no departure from the normal can be detected. Dogs which have undergone this inoculation have proved to be completely resistant to the disease thereafter, whether exposed to infection by being placed in close contact with animals suffering from the disease or by the administration of infective material.

The preparation and administration of the vaccine require especial skill, but arrangements are under way for large scale production so that the protective material will soon be available generally. Sufficient time has not yet elapsed to judge of how long the protection will last, but it is thought unlikely that it will decrease.

Distemper, of course, is not exactly the same as the human disease of influenza, but it is an acute bronchial or respiratory disease of dogs. The importance of the present work is not limited to the canine field. The complete solution of the problem demands the cultivation of the virus apart from the living animal. Any advance in the knowledge of one virus will probably advance greatly our knowledge in the entire field of virus cultivation and study. Since so many human diseases, including influenza, depend on greater knowledge of viruses, there is hope that the work of the Distemper Research Committee will contribute greatly to the prevention of human diseases.—*Science Service.*

Trap-Shooting at Midnight

UNDER midnight skies and 2,000,000 candlepower in electric floodlights, three veteran trap-shooters, the oldest of whom was 81, recently broke from 19 to 23 clay pigeons out of a possible 25. This happened at the first night-time trapshoot ever held, while a gallery of 400 spectators watched shattered clay pigeons fall at the range of the Lynn Fish and Game Association, at Lynn, Massachusetts.

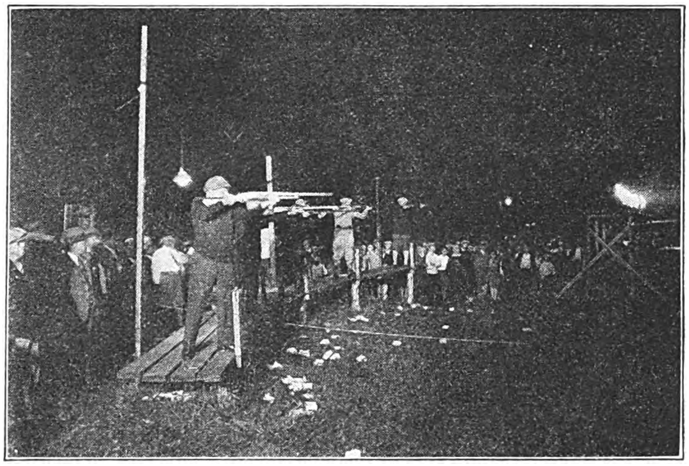
Attracted by the novelty of shooting at clay pigeons as an evening recreation, nearly 60 trap-shooters from all over New England took part in the four events of the program. The dean of them was Norris G. Rowell, of Lynn, who is 81; his two fellow-veterans were Dr. F. L. Judkins, of Lynn, former New England champion, 75, and F. A. Farrington, of Peabody, Massachusetts, 73.

They experienced new thrills as they stood on the shooting platform and looked out toward the trap-houses, from which the clay pigeons were sent into the air 50 or 60 feet from the shooters, flying in the glare of 20 powerful floodlight projectors mounted on platforms 20 feet high.

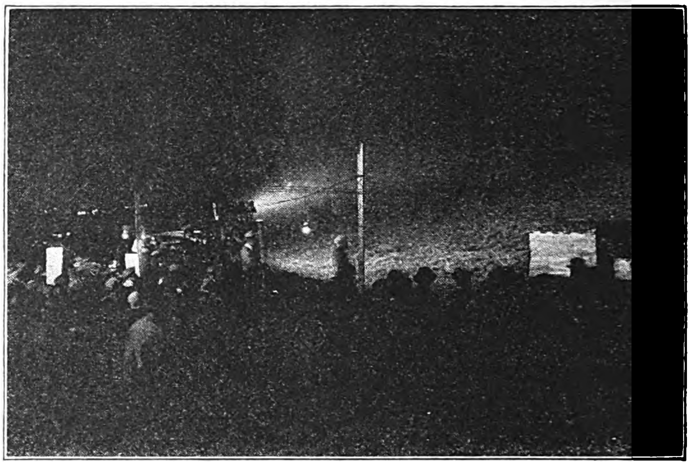
"Yes, the idea is a good one," said Mr. Farrington, after the shoot was over. "It gives a man as good a chance to break the targets as it does in the day-time. It also gives a chance to the man who cannot devote time to the sport during the day. It will get more men interested in the game. I think it is going to be the popular way. Good scores can be made, and I think it is a big thing."

His prediction seemed justified as trapshooters flocked to the range night after night to try it out, until a few nights later William Hill, professional gunner at Bridgeport, Connecticut, made a perfect score under the flood-lights—25 birds out of 25.

Lighting engineers of the General Electric Company, particularly F. W. Ralston, street-lighting engineer, laid out the lighting scheme. There were various problems to be overcome, such as making the pigeons sufficiently visible, the location of the flood-lighting units to avoid interference with the shooting, the lighting of the gunners and their guns, and special lighting facilities to assist the gunners in sighting.



Trapshooting at night by the light from searchlights promises to become popular, judging by results achieved



A view behind the traps at the recent experimental trapshooting meet held at night. Note searchlights

Electric Machinery Cooled by Hydrogen Gas

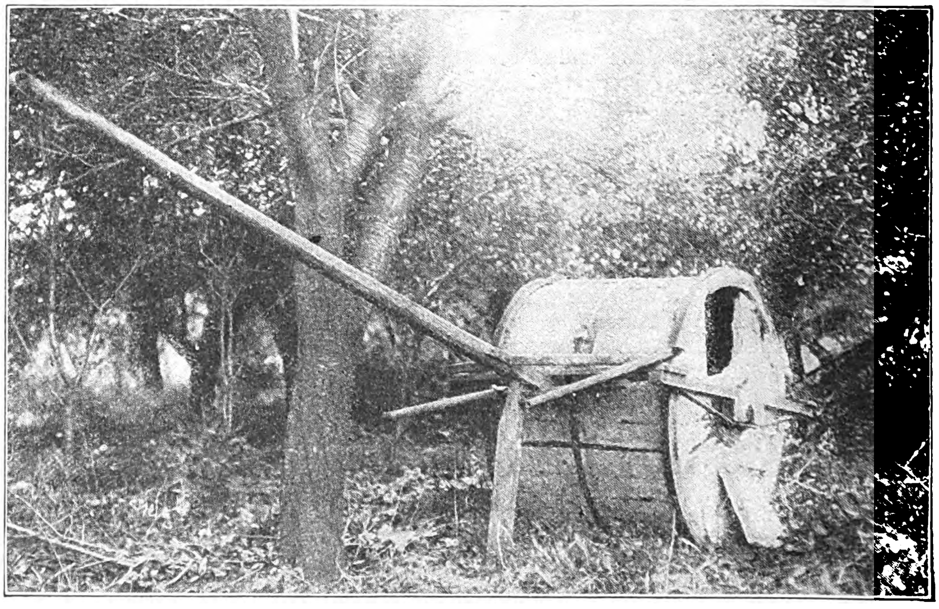
AS much as 50 percent more power can be handled by the same size electrical apparatus if it is equipped with a new system of cooling developed by the General Electric Company, it was announced by that company recently. The use of hydrogen gas within a totally enclosed rotating machine has made this increase possible without increasing the operating temperature beyond the point of safety, the company reports, and it is the temperature which has heretofore limited the load which can be carried.

The first commercial application of the new system of hydrogen cooling has been made on a synchronous condenser installed by the New England Power Company at its Pawtucket, Rhode Island, substation, which has a capacity of 12,500 kilovolt-amperes, as compared with only 10,000 kilovolt-amperes if an air-cooling system were not used. With hydrogen at 15 pounds gage pressure, the machine would deliver 15,000 kilovolt-amperes without exceeding the normal temperature guarantees, according to General Electric engineers.

Another advantage of the new system, it is said, is to exclude oxygen and dirt. Hydrogen will not support combustion, and fires of any kind, even from short-circuits, are consequently impossible, it is further declared. Hydrogen also eliminates the effect of corona on the insulation, the report says. The usual air-cooled machine must be placed within a building, but the hydrogen-cooled equipment can be placed outdoors, which is the case at Pawtucket, thus saving building costs. The totally enclosed apparatus is also said to be exceptionally quiet in operation.

Niagara Will Be Saved

EARLY in January and shortly after publication in our January issue of the article "Niagara Should Be Saved,"



Ingenuity is not confined to industry by any means. This practical concrete mixer, described in these columns, was constructed by a mid-western farmer

William Mackenzie King, Prime Minister of Canada, and William Phillips, the American Minister, signed, in Washington, D. C., an accord authorizing the construction of the remedial works recommended by the International Niagara Board and outlined in our article. The work is to consist primarily of submerged weirs and excavations in the rapids above the Falls, intended to preserve the scenic beauty of the Falls and to permit diversion of more water for power generation purposes.

A protocol describing the details of the proposed works was signed at the time the agreement was reached and will now have to be ratified by Congress.

The work, which is to cost around 2,000,000 dollars, will be carried out under the supervision of the United States and Canada by the Niagara Falls Power Company and the Hydro-electric Power Commission of Ontario.

Ingenious Home-Made Concrete Mixer

MUCH has been said and written regarding the native ingenuity of the average American and many contrivances in proof of it are constantly coming to light. One that has just come to our attention is a home-made concrete mixer of great capacity which was constructed by a farmer living near Kansasville, Wisconsin, and used by him to prepare concrete for use in improving his farm. The mixer is a two horsepower affair: two horses supply the power to operate it.

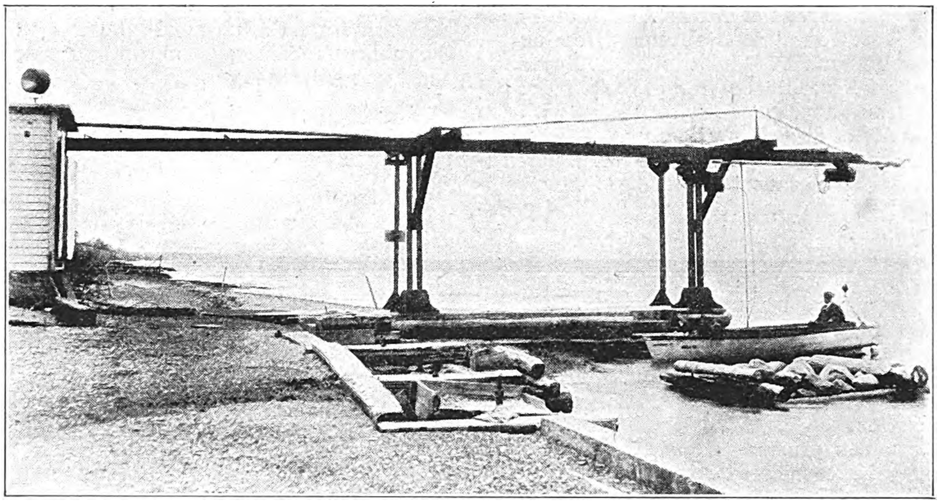
This "horse-power" concrete mixer is a large, barrel-like container with an axle through its center and with steel blades bolted to the inside. Cement, sand, stone, and water, in the proper proportions, are placed in the mixer through an opening in the side, a cover is placed over this doorway, and a team of horses is hitched to the tongue. After they have pulled the mixer for a few hundred feet, the concrete is ready for use.

Compressed Air Aids Shade Trees

COMPRESSED air forced in among the roots of large trees that have been transplanted has been found to be of assistance in causing the tree to recover quickly from the disturbance, as in most planting operations the dirt is thrown back into the soil with so much water that it puddles and prevents the roots from getting necessary air from the soil.

The same compressed air treatment is stimulating to trees in lawns where, apparently, the roots of the densely matted grasses forming the sod sometimes release so much carbon dioxide in respiration that the supply of oxygen in the soil is dangerously reduced. The method can also be applied to street trees which suffer greatly from leaking gas mains and from soil compactness due to paving, or to park trees where the soil is badly trampled by crowds.

The air is supplied by any air pump such as those used to fill air tanks at service stations or for pneumatic drills and hammers, and is forced into the soil through a deep nozzle. Many dying shade and ornamental trees can be encouraged to take a new lease upon life by a treatment of compressed air.—*Science Service.*



A new electric boat hoist. Two electric motors do all the work of launching or removing a boat from the water. One motor lifts the boat and the other carries it along the overhead track. Each is operated by a control rope. Trolley wires carrying the necessary current are strung along the track

Efficient Freight Bracing System

A PROBLEM of great importance with many manufacturers of today is the proper stowing and bracing of carload freight shipments.

While railroad equipment has been redesigned and strengthened to carry greatly increased traffic at higher speeds to meet the demands of present day business, until recently little thought was given to improvement of bracing for securing various types of ladings in the freight cars. Various forms of wooden blocking had been worked out. These methods were slow, costly, and did not insure safety for the cargo to any certain degree. Wooden bracing is applied to the walls and floors of the freight car and causes the cargo to become, in effect, a part of the car itself. It is apparent that this condition offers a resistance to the shocks rather than a means of absorbing them. Staggering damage claims, amounting to as much as 38,000,000 dollars annually, made it imperative that more efficient ways and means of bracing freight would have to be devised.

About three years ago, a new scheme of bracing was first tried out. This method, known as Unit-Load, employs heavy steel bands to draw the individual packages comprising the load into compact units, binding them tightly together so that, in effect, single units of great mass are created. Under very heavy impacts the units are free to shift slightly in the car. The steel bands about these units are not attached to the car walls or floor but are

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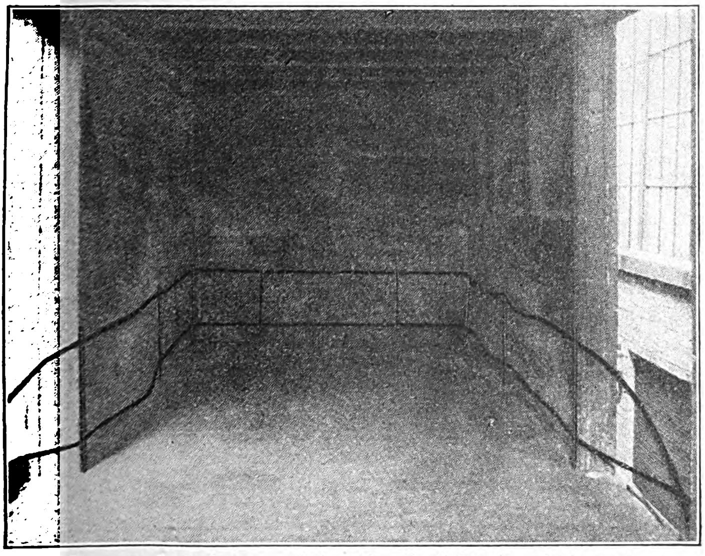
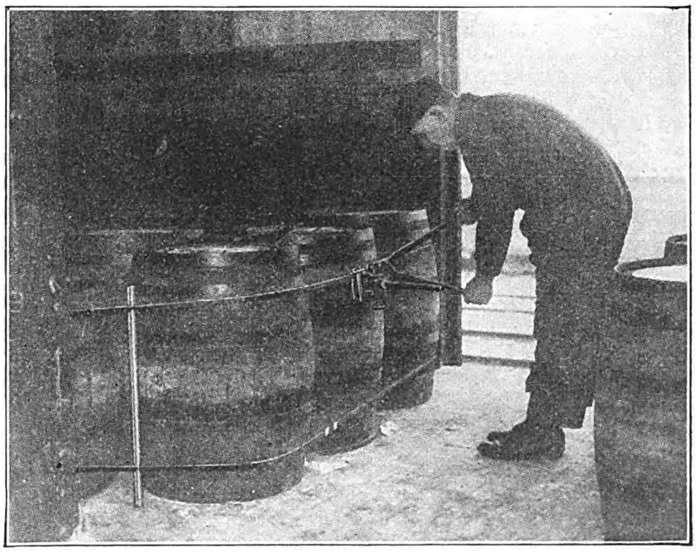


The steel strips used in the freight bracing system are spaced by vertical strips, which are tacked to wall



When the freight is in place, the workman clamps the steel strips together. This pulls strips from the wall

Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Spontaneous Heating of Coal

THE Bureau of Mines' Technical Paper 409, on "Spontaneous Heating of Coal," by J. D. Davis and D. A. Reynolds, presents a critical review of the work of the bureau on this subject, correlated with the results of other investigators. The results of chemical and physical research, particularly those of most recent date, are assembled in abstract form and critically examined. Some of the general conclusions reached in this study follow:

1. All coals but anthracites undergo spontaneous heating; the liability of self-heating is greatest among coals of lowest rank.
2. Oxidation of the coal substance itself is the main cause of spontaneous combustion.
3. The process of spontaneous heating may be considered to take place in two stages. The first stage is operative at room temperature as soon as freshly broken coal is exposed to the air. It begins with the physical absorption of oxygen and is continued by the formation of a solid chemical compound of coal and oxygen, which is gradually decomposed as the temperature rises. This first stage of the process generates heat, but not as much as the second stage. The second stage involves the breaking up of the solid compound of coal with oxygen and the formation of the final oxidation products—carbon dioxide, carbon monoxide, and water.
4. Pyrite when finely divided can increase the tendency of a coal to heat spontaneously.
5. Opinions differ as to what effect moisture in coal has on spontaneous heating. Probably the effect of moisture is determined by the conditions of storage. If one could be sure of wetting only those parts of the storage pile where spontaneous heating would otherwise develop, he could very probably prevent it; the heat required to vaporize the water would be more than the oxidizing coal could supply. However, wetting down the surface of the whole pile changes the conditions of ventilation and may favor heating at points not reached by the water, where dangerous heating would not otherwise occur.
6. Chemical factors other than those touched upon in paragraphs 1 to 5 above have little or no influence on the spontaneous heating of coal.

Electronic Bombardment Said to Synthesize Rubber

SYNTHETIC rubber enthusiasts may get fresh encouragement from the announcement that in Germany, H. Plauson, noted physicist, has discovered a mode of producing chemical rays through a modification of the Coolidge and Leonard tubes that can polymerize isoprene, butadiene, and their homologs and analogs to caoutchouc with great rapidity, and that can even convert rubber solutions into an insoluble state without the use of sulfur.

From the purely scientific standpoint the report is perfectly acceptable, but it should be taken with the realization that the path from the physical laboratory to the rubber tire factory is long and torturous and beset with many dangers.

Chemists Compress Years Into Days

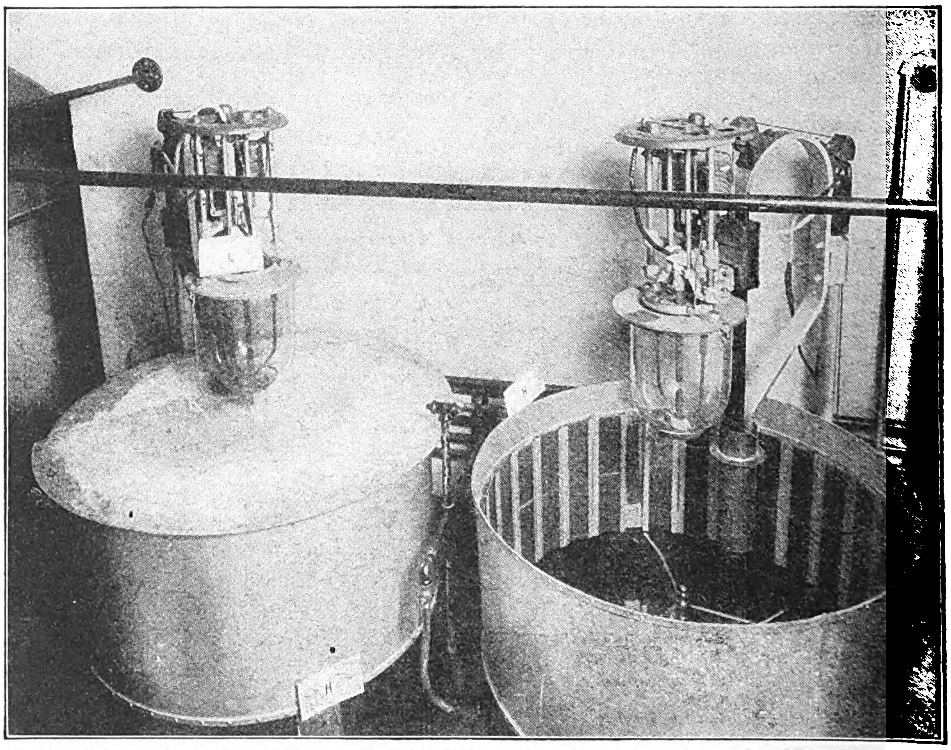
"BACKWARD, turn backward, Oh Time in thy flight—" sings the poet, but the chemist more often has reason for reversing the sentiment—"Hurry on Time, so that we can see how this new material is going to stand up." In the field of protective coatings this desire is especially urgent, and the chemists' attempt to peer into the immediate future has resulted in the development of numerous ingenious "accelerated weathering tests" calculated to reveal, in a comparatively short time, the effect of long exposure to the elements. Light, moisture, temperature changes, and normal air are the important causes of decay of paint, varnish, and other organic protective coatings. In general, the most important of these is light.

The United States Bureau of Standards has devised the exposure chamber illustrated here for testing small panels painted with the material under investigation. The chamber for exposure to light and moisture consists of a rotating cylinder made of 16 gage galvanized iron, 30 inches in diameter, 15 inches high, open at both ends, with the light suspended in the center. This size was selected so as to bring the light as near the panels as possible, at the same time avoiding too high temperatures. The cylinder has a capacity of 60 three by six inch panels.

The test panels are placed in two tiers immediately opposite the light inside the cylinder, the panels thus being 15 inches from the center of the light source. This gives a temperature of about 52 to 55 degrees, Centrigrade, at the panels with the type of lamp used. Thirty slotted holders, three inches wide and about 13 inches long for panels three inches wide, are attached to the inner surface of the open cylinder. The exposure cylinder is provided with water sprays, so that it is possible to expose the panels in succession to intense light and to a variety of moisture conditions. A pan placed in the bottom of the cylinder contains water and serves to keep the temperature down to about 52 degrees, Centigrade, next to the panels, as well as to humidify the air. Separate cabinets for exposure to gases and refrigeration are provided.

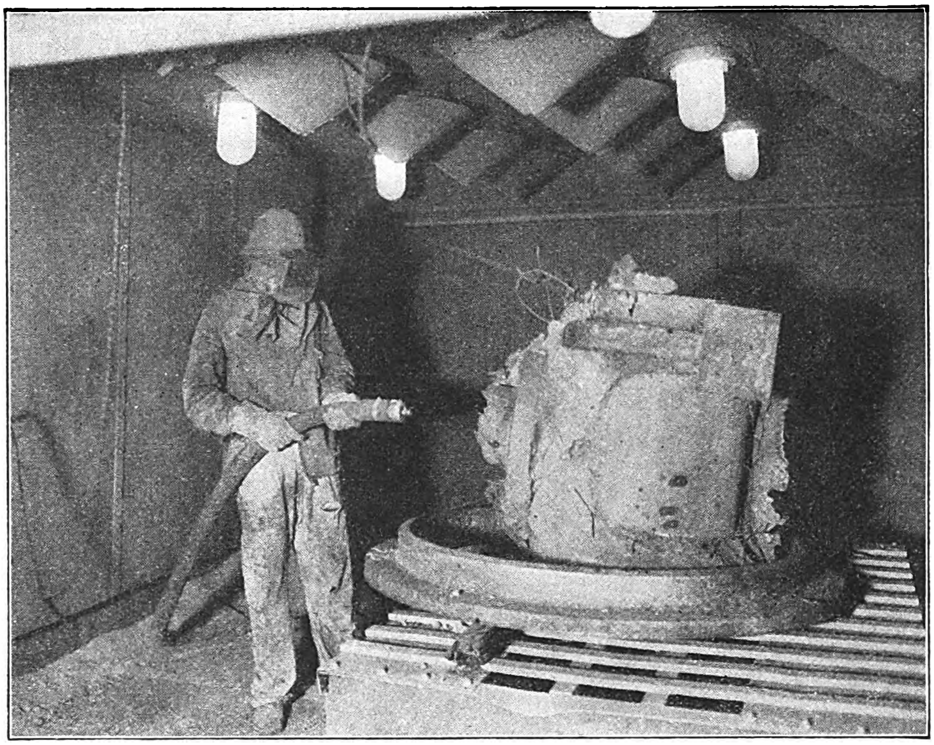
In addition to light exposure, the panels are subjected from time to time to several hours of vigorous spraying with warm (100 degrees, Fahrenheit) water. The panels can be removed to a special chamber for this purpose, but it is more convenient to produce this artificial rain in the chamber used for the light exposure. For this purpose the light is raised out of the cylinder, a common rotating lawn sprinkler is put in, and the top of the cylinder holding the samples is covered by a galvanized iron lid.

The illustration shows the arrangement for spraying the panels with water. The right-hand unit with the cover removed



To determine the comparative qualities of paint samples, the Bureau of Standards has designed this exposure chamber. It rotates slowly, exposing painted panels to the weathering action of a sprinkler or a brilliant arc light shows the rotating spray, the slots containing test panels, and the protecting tube over the lower part of the lamp support. The left-hand unit shows the lid in place.

In order to simulate a hot, humid climate, a fixed water spray has been mounted in the tank in such a manner that it may function when the lights are operating.—*From an article published in* Bureau of Standards Journal of Research *for July, 1928 (Vol. 1, No. 1) under title of "Accelerated Tests of Organic Protective Coatings," by Percy H. Walker and E. F. Hickson.*



A sand blast operator in a special compartment, about to begin work on a large casting. Protected from the dust-filled atmosphere within the chamber by a special helmet, the operator receives fresh air by means of a small hose

Bakelite and Asbestos Combined in New Acid-Proof Material

AMONG the new materials of construction for corrosion-proof equipment is a unique synthetic product known as Haveg. It is said to be unaffected by non-oxidising inorganic and organic acids and other reagents. It stands a temperature of about 130 degrees, Centigrade. In spite of its lightness (its specific gravity is 1.6) it withstands a pressure of about 5.2 tons per square inch and a bending strain of about 2.8 tons. It is composed of Bakelite, the well-known artificial resin, mixed with asbestos fibers. From the list given of acids by which it is unaffected, it appears to have considerable possibilities wherever acid or neutral baths, or solutions made alkaline with soda ash are employed. It is not suitable for caustic soda solutions.

Vacuum Distillation Produced Pure Manganese

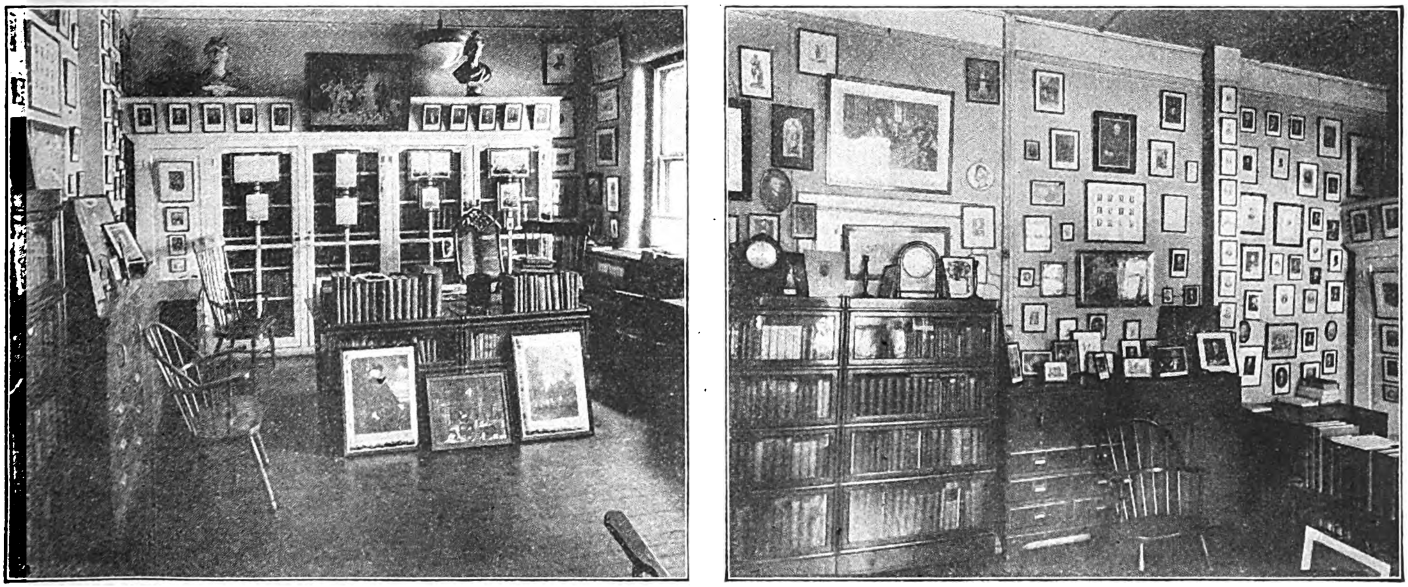
PURE manganese has recently been produced in the Bureau of Metallurgical Research of the Carnegie Institute of Technology. Samples of the metal, which never before has been produced in quantity in such a purified state, and of the furnace in which it was made, were exhibited at the open meeting of the Metallurgical Advisory Board held in Pittsburgh recently.

Pure manganese has a bright silvery luster, and unlike many pure metals which are soft and ductile, it is extremely brittle and hard enough to scratch glass. The pure metal was distilled from crude metallic manganese placed in a pure magnesia crucible over which a similar crucible was inverted to condense the manganese vapor. The whole was placed in a closed silica tube connected with a high vacuum pump and heated by high-frequency induction using an alternating current of several amperes at a frequency of 20 kilocycles.

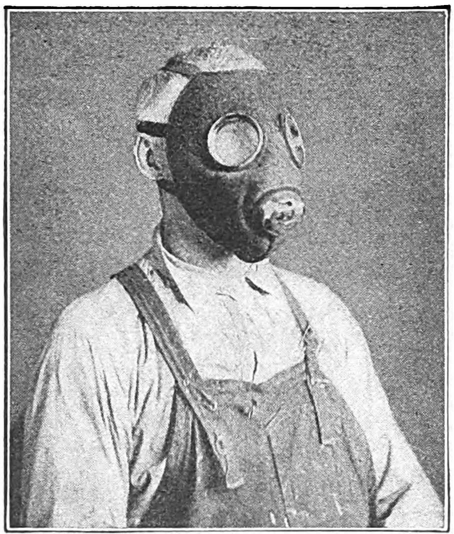
Predict Cement As By-Product of Fertilizer Manufacture

CEMENT and fertilizer are products of two great industries built upon principles of chemistry, but there is no apparent relationship between the two manufacturing processes as conducted in the United States except this mutual kinship to chemistry. Reports from abroad however, indicate that the extension of chemical technique may result in the production of cement as a "by-product" of fertilizer manufacture.

According to *Chemiker-Zeitung*, the erection of factories in France for the production of ammonium sulfate and cement by the Leverkusen process has been held up, as it is thought possible to convert gypsum into ammonium sulfate as in the method of the Badische company, together with the simultaneous production of cement. M. Baud, the discoverer of the new method, carries out the reaction between gypsum and ammonia under a pressure of about one atmosphere in the presence of carbon dioxide and loam, which, by reaction with calcium carbonate, gives a sludge. This, after complete washing out of the ammonium sulfate, is heated to 1500 degrees, Centigrade, whereby cement clinker of normal composition is formed. The solution contains 27 to 28 percent of ammonium sulfate. The German account states that a con-



Two views of the office of the late Dr. Edgar Fahs Smith, noted educator and former President of the American Chemical Society. His collection of chemical memorabilia, one of the most valuable of its kind, has been presented to the University of Pennsylvania by Dr. Smith's widow, and will remain in its present setting



An English "full mask" dust respirator with loose felt filter, check valve for exhalation, and goggles

flict is at present in progress between the producers of ammonium sulfate (who regard this as the best nitrogenous fertilizer) and the producers of calcium nitrate, who oxidize synthetic ammonia by the Bamag or Parsons method.

Weed Killer Developed to Utilize Surplus Chlorine

AN Australian fertilizer producer, who also makes caustic soda by the electrolytic process, has found a use for the surplus chlorine that is generated in the process of electrolysing the salt solution. It is proposed to manufacture calcium chlorate, which has been found to exert a marked destructive effect on weeds. Experiments carried out under the direction of the Victorian Railways Commissioners, states the *Fertilizers and Feeding Stuffs Journal*, showed a 100 percent kill on weed-infested areas. In addition to being relatively cheaper than sodium arsenite, this material is non-poisonous, non-corrosive, and non-irritant to the hands of the operators. It is to be marketed under the name of "Weedex."

Motor Fuel From Sawdust is Indian Project

FAVORABLE results are being obtained in India on the experimental production of alcohol from sawdust of the gangwa tree, a fast-growing species, according to the Department of Commerce. Alcohol is regarded as the logical basis of motor fuel in India.

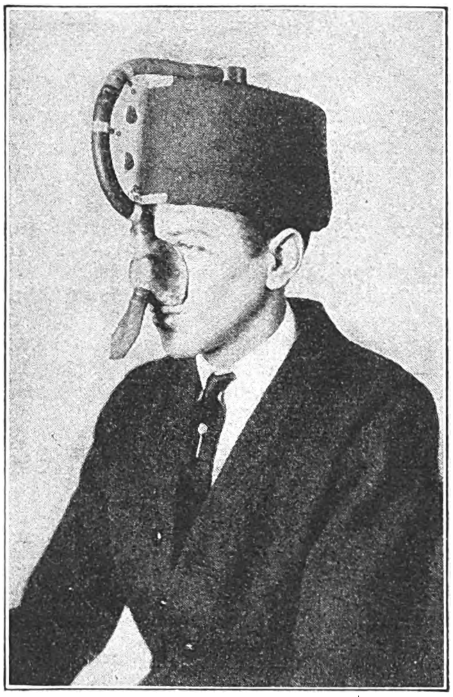
The glucose obtained is fermented to alcohol, and it has been roughly calculated that waste sawdust from Calcutta mills alone would yield 375,000 gallons of power alcohol yearly, on the basis of experiments using sulfuric acid. The use of fuming hydrochloric acid would give 40 percent greater yields, which would then amount to one sixth the production in India from all sources. Only 3,000,000 gallons are being produced locally at present.

In the experimental work which is being conducted at the University of Calcutta, yields of 30 to 33 percent reducing sugar (glucose) have been obtained from sawmill waste by treatment with sulfuric acid; 70 percent of this sugar material was fermentable, giving 33 to 39 gallons of 90 percent alcohol per ton of air-dried sawdust. The use of fuming hydrochloric acid in the initial hydrolysis gave higher yields of reducing sugar and 48 to 57 gallons of alcohol per ton of sawdust. Special acid-resisting vessels, such as are being manufactured now from synthetic plastics, would be required if hydrochloric acid is used.

Demobilized Gas Masks Find Jobs in Industry

IN its investigations relating to the safety and health of workers in the mineral industries the United States Bureau of Mines has given attention to the danger from breathing dusts, the means by which the workers might be protected, and the merits of dust respirators.

Poisonous dusts, such as those bearing lead or arsenic; some rock dusts, such as silica; metallic dusts, including those produced in grinding and polishing shops; and many other dusts, including some organic dusts such as those in textile mills, are injurious when constantly breathed. Hard-rock miners, stonecutters, glassworkers, potters, and metal grinders are particularly exposed to this hazard. Everyone occasionally encounters a dusty atmosphere and experiences discomfort from it.



This newly developed respirator of the Bureau of Mines gives more filtering space and aids respiration

Gas masks and respirators are also demanded by conditions in certain paint-spraying operations. Operators of spray-guns are usually within arm's length of the gun being manipulated and may breathe some spray that fails to lodge upon the surface; also they may breathe vapors of paint solvents and thinners. When using paints that contain lead or other poisonous pigments it is best that the operator of the spray-gun be protected from inhaling the mist. Some paint solvents such as benzol, which has sometimes been used, or thinners, may evolve vapors detrimental to health.

Public Health Bulletin Number 177 states as a result of the tests that, in general, the respirators with cotton, paper, or fabric filters remove 90 percent or more of the lead from air carrying paint mist. These respirators restrain none of the solvent vapors. The addition of a canister or cartridge of activated charcoal to the respirator removes all solvent vapors until the charcoal becomes saturated. The useful life of filters is determined by their increase in resistance, which necessitates changing for fresh filters at intervals of several hours. When charcoal is saturated the cartridge must be exchanged for a fresh one. Canisters of the size used with gas masks may last for weeks before a change is necessary.

The respirators were somewhat less efficient against the silica-dust sprays, but they restrained 24 percent or more of the dust from the air passed through them; most were more than 50 percent efficient.

Emulsification of Asphalt Produces New Paint

AN entirely new paint material for the protection of surfaces exposed to severe conditions of corrosion has been made available by recent development of asphalt emulsions in water. The valuable properties of asphalt have long been recognized but heretofore this material has been applied either in a molten condition or in solution in volatile solvents. Neither of these methods of application are entirely satisfactory from the standpoints of effectiveness, convenience, or economy.

The progress of manufacture of asphalt emulsions involves the breaking up of the substance into extremely minute particles averaging from 1/5000 to 1/10,000 of an inch in diameter in the presence of water and a very small percentage of an inert mineral colloid. This is accomplished by flowing pure asphalt into an especially designed speed emulsifying machine in which propellers disperse the stream of asphalt into minute particles and at the same time combine it with water and the colloid. In this way the particles of asphalt are suspended and held in suspension until after the emulsion has been applied.

The importance which the paint industry attaches to this new development is indicated by the recent announcement that the duPont Company has joined forces with the Flintkote Company of Boston to

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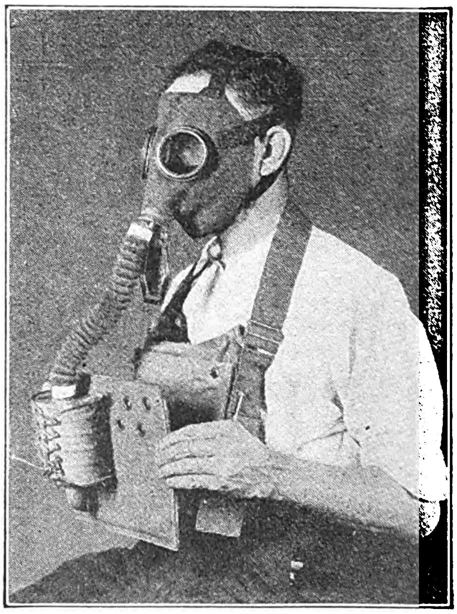
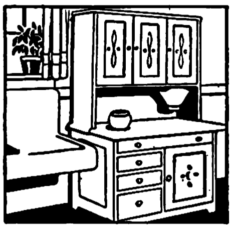


For protection from dust only, the charcoal canister is omitted from this Fogler flat felt filter and mask

For hand made samples or production by thousands this *grainless* wood board

A business crisis. New models to build. Samples wanted yesterday and production costs skyrocketing. In just such emergencies industrial executives have turned to Masonite Presdwood, the easily worked, grainless wood board. In your business, too, it may be found profitable. May we send you samples with which to experiment?



FOR KITCHEN CABINETS

In the changing times that demand new methods, for the new competition that requires new products, there is an ever growing industrial need for Masonite Presdwood—with the strength, the lightness, the extreme workability that only this grainless wood board can give.

Skilled mechanics in the tool room, foremen in charge of big punch presses, find nothing in Presdwood to dull keen tools or wear out dies before their time.

For Presdwood is just clean wood that is blown apart and then pressed together, under tons and tons of pressure.

Because Presdwood does not warp, crack, split or buckle, there are no costly rejections in final inspection. And because it comes in ⅛th and ³⁄₁₆th inch thicknesses and in standard 4 foot by 12 foot boards, there is almost no waste to boost production costs.

Resists Moisture — Takes any Finish

These grainless boards are smooth as glass on one side and textured like canvas on the other. The smooth hard surface with its delicate brown shading is naturally beautiful. The material resists moisture and requires no paint for protection. It can either be left in its natural state or finished to represent the finest type of natural wood.

Presdwood is used in both building and industry. It panels apartments. It lines closets and elevator shafts. It makes smooth, light shelving and attractive partitions. It is the all 'round material for the inventor, the handy man, the home owner, as well as a product that is revolutionizing manufacturing methods.

FOR PUNCH PRESS OPERATIONS

From Toys to Motor Trucks

It is used for kitchen cabinets, starch trays in candy factories, doll houses and toys, hydroplanes and outdoor signs, table and work bench tops and the sides of panel bodies on motor trucks. And wherever used, it fills a need that is exactly met by no other material.

It pays to keep up with new methods and products. And it pays to know just what Presdwood can do in any manufacturing situation and for any specific purpose.

Samples to use in experimental work will be sent promptly on request.

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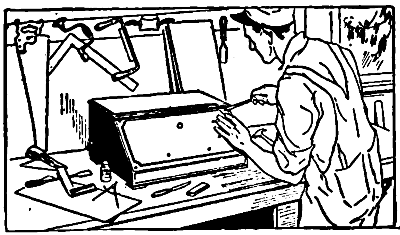
FOR RADIO CABINETS



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Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Aviation

FOURTEENTH ANNUAL REPORT OF THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS (1928) is the official governmental survey of the present status of the aviation industry. It reports the activities and progress of the committee, with a comprehensive review of the fundamental problems of flight and the technical advances made during the first 25 years of aviation history. *United States Government Printing Office, Washington, D. C.—20 cents.*

THE AVIATION INDUSTRY is a well executed review of the development of aviation in the United States with particular reference to the commercial aspects of the industry. It includes statistics of air mail and other flying operations, and reviews the scope and activities of the more important operators and manufacturers of aircraft, engines, and accessories. *Pynchon and Company, 111 Broadway, New York City.—Gratis.*

SURVEY OF THE AERONAUTICAL INDUSTRY IN THE NEW YORK METROPOLITAN DISTRICT analyzes the commercial aspects of the industry in the region covered, with a survey of the airplane transportation service available at the 17 flying fields of the metropolitan area. *The Merchants Association, 233 Broadway, New York City.—Gratis.*

Agriculture

AGRICULTURAL CORPORATIONS and SOCIALIZING THE SOULLESS CORPORATION, by Robert S. Brookings, are reprints of two papers that have appeared recently in the daily press. Mr. Brookings is a profound admirer of the methods of Henry Ford, and utilizes the well-known activities of the Campbell Farming Corporation in Montana as a model of agricultural engineering of the sort that will solve the ills of the farmer. The second paper is intended to bring out the fact that corporation methods will function in a chain of small farms as successfully as such methods have proved in chain store merchandising. *The Brookings Institution, Washington, D. C.—Gratis.*

MILK—FROM FARM TO REFRIGERATOR tells the story of the processes used by metropolitan milk distributors in gathering, preparing, and marketing their product. *Philadelphia Inter-State Dairy Council, 219 North Broad Street, Philadelphia, Pa.—Gratis.*

Forestry

DEFORESTED AMERICA, by Major George P. Ahern, with an introduction by Gifford Pinchot, presents the alarmist's views regarding our timber resources, the rate at which those resources are disappearing and what should be done about it. Certain interests may dislike Major Ahern's outspoken word-picture, but everyone interested in forest conservation will read it with real interest. *Deforested America, 1617 Rhode Island Avenue, Washington, D. C.—25 cents.*

THE PROTECTION FORESTS OF THE MISSISSIPPI RIVER WATERSHED AND THEIR PART IN FLOOD PREVENTION (CIRCULAR NO. 37) discusses the natural causes of the devastating floods in the Mississippi River basin. *United States Department of Agriculture, Washington, D. C.—Gratis.*

Safety

WHEN THE EMERGENCY ARISES FOLLOWING A MINE EXPLOSION OR FIRE is a pamphlet describing the equipment for a complete mine rescue station and information regarding the disposition of men and equipment for fire fighting and recovery following a mine explosion. Other booklets on kindred subjects will be furnished gratis by the same firm. *Mine Safety Appliances Company, Pittsburgh, Pa.—Gratis.*

Ready for any emergency, this miner is equipped for rescue work in gas filled mines after an explosion

Thermodynamics

THE INTERNATIONAL TEMPERATURE SCALE, by George K. Burgess, is a reprint from a paper which appeared in the *Bureau of Standards Journal of Research* in October, 1928. *United States Government Printing Office, Washington, D. C.—Five cents.*

DEFINITIONS, NOMENCLATURE, SYMBOLS, AND UNITS FOR HEAT TRANSMISSION, the report of the Committee on Heat Transmission of the National Research Council, is intended to clarify and standardize the terms used in the science of heat transmission. *National Research Council, 40 West 40 Street, New York City.—25 cents.*

Trade

THE WHOLESALE GROCER'S PROBLEMS presents a simple, workable method of computing the cost of handling individual commodities, a diagnosis of the "small order" problem, and considers ways of fitting the inventory to consumer requirements. The text is well illustrated with charts and tables based on actual figures collected by the bureau. *Bureau of Foreign and Domestic Commerce, Washington, D. C.—Gratis.*

GOVERNMENT PUBLICATIONS RELATING TO TEXTILES and PRACTICAL AIDS TO THE TEXTILE INDUSTRY are recently issued bulletins of interest to the manufacturer in the textile field. *Bureau of Foreign and Domestic Commerce, Washington, D. C.—Gratis.*

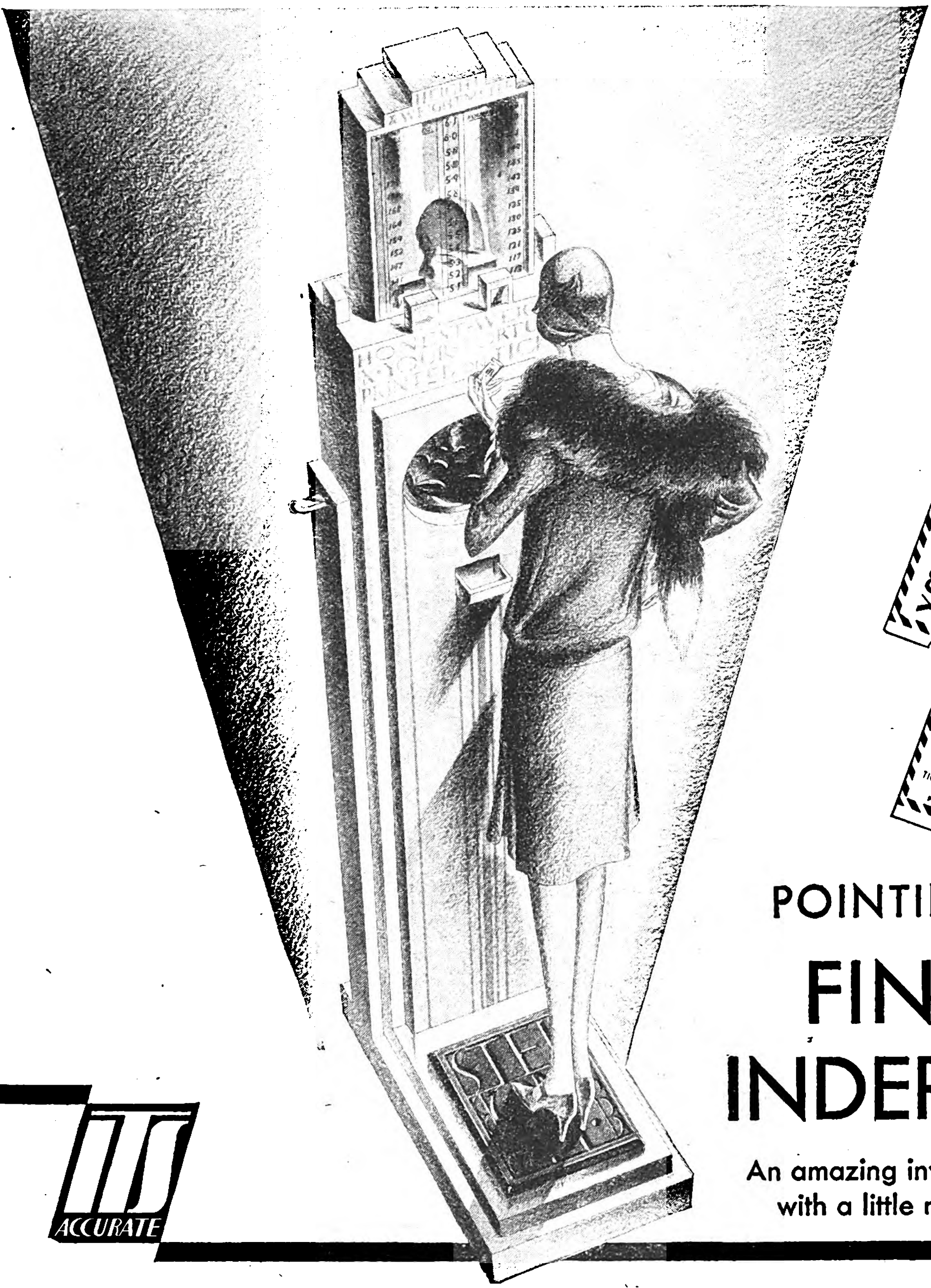
Miscellaneous

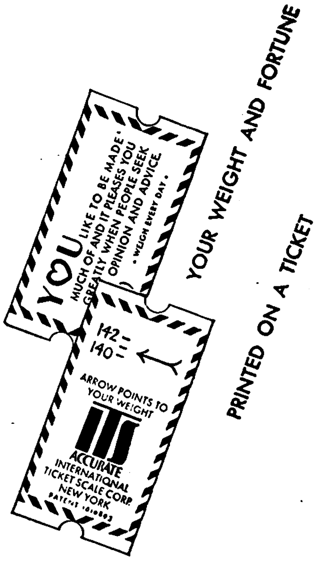
AMATEUR RADIO STATIONS IN THE UNITED STATES lists all amateur stations and experimental, technical, and training school stations. The location of each station is given, the name of its owner, its call signal, and power used. *United States Government Printing Office, Washington, D. C.—25 cents.*

THE POST-WAR MOVEMENTS TO REDUCE NAVAL ARMAMENTS, by John C. Shillock, Jr., has an introduction by Nicholas Murray Butler discussing the Pact of Paris, and a good bibliography on the general subject of international relations and defense. Mr. Shillock's attitude is Wilsonian, optimistic, and inclines toward the opinion that evolution and the League of Nations will eventually bring about the desired result. *Carnegie Endowment for International Peace, 44 Portland Street, Worcester, Mass.—Five cents.*

HOW POWDERED COAL STANDS TODAY is a reprint from an article by Henry Kreisinger published in *Power* some months ago. Consideration is given to many types of new installations and change-overs, where operating efficiency may be increased by using pulverized coal. *Combustion Engineering Corporation, 200 Madison Avenue, New York City.—Gratis.*

TIDAL CURRENT CHARTS, NEW YORK HARBOR, gives a visual schematic representation of the tidal currents at various localities throughout the harbor and a comprehensive view of the tidal current movement for the harbor as a whole. *Director of the United States Coast and Geodetic Survey, Washington, D. C.—25 cents.*

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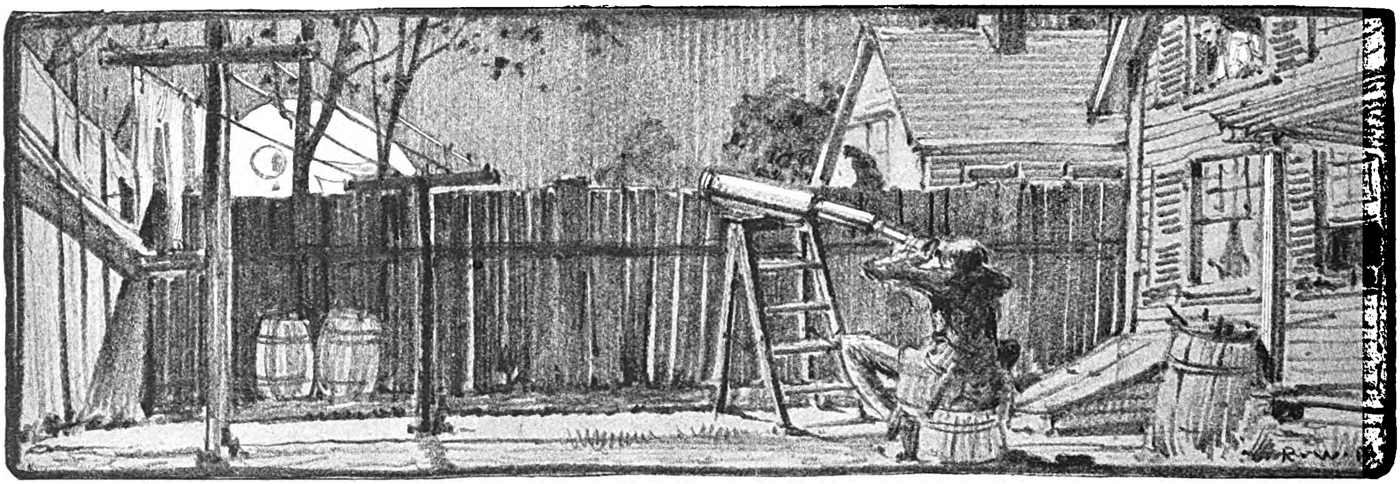


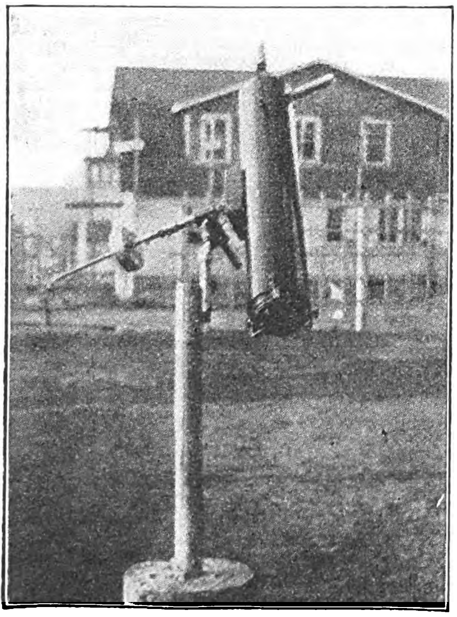
The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

THIS month we illustrate two telescopes made by clergymen. These are the real "sky pilots." They no doubt find heavenly inspiration for sermons—or inspiration for heavenly sermons—at the eyepiece. The first letter comes from Rev. Harold N. Cutler, Rector of St. Paul's Episcopal Church at North Arlington, New Jersey, who states:

"The writer of this note is a clergyman who became tremendously interested in telescope building through your book for amateurs on the subject. My reflector is four inches in aperture, with a focal length of 34 inches and it cost me only $3.45, exclusive of the eye pieces.

"I procured two disks of glass, four inches in diameter, half-inch thick, for 60 cents with ground edges, from a Newark plate glass company. The rouge, carbo, chemicals and so on, made up the rest. Great attention was paid to the fine grinding. Flour emery was used until I was 'blue in the face' but it paid handsomely when it came to the polishing. The radius of the curve was 72 inches but it shortened to 68 inches during the polishing. I will never forget those shadow tests. The first series showed I had a regular well dug in the center of the mirror, so I cut out the center of the tool and soon had a sphere. I used a goodly proportion of beeswax in the pitch lap. The final parabolizing was done in a total of about ten minutes of actual work, but it involved nearly a whole night of waiting and testing—I'll never forget that 'session.'



Reverend Cutler's four-inch reflector

"A taxi smashed up on our corner, so a piece of its windshield formed the diagonal. The silvering, according to your instructions, went very easily—except, I may add, that I silvered everything in sight.

"The mirror was set in the cover of a coffee can. This was bolted by long screws to the back of an old radio dial. I used this because this type has three rather heavy springs. The whole thing adjusts like a million dollars. This assembly was fixed to the end of the tube with three brass clamps. The tube was stove pipe (20 cents) with a band of heavy galvanized iron on each end.

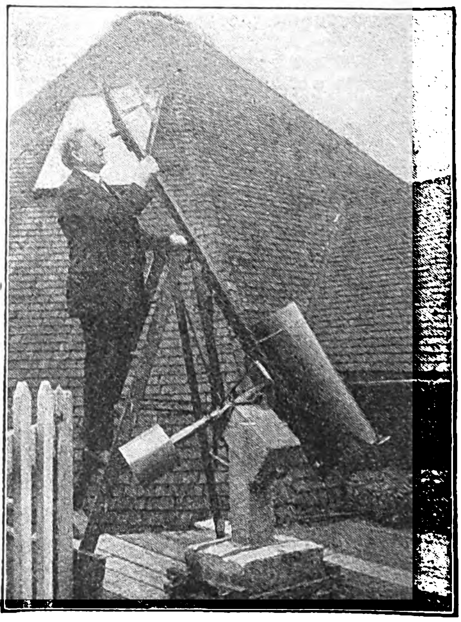
"The mounting is crude—plumber's fittings. A floor flange was bolted to the tube and a piece of half-inch pipe was screwed into it for a declination axis. The latter was inserted in a "T" which was drilled for set screws and lined with sheet copper to take up the play. The fitting for the eyepiece was a problem until an old drain fitting was found, providing the flange and tube. The finder is a small one dollar telescope but it doesn't work half as well as simply sighting along the tube as one would aim a gun. Later, I replaced the diagonal mirror with a one-inch prism and the result is more than worth the cost. I am using ordinary microscope eyepieces.

"I love to view God's heavens through my reflector. It is a 'grand and glorious feeling' to see Jupiter and her moons and the other wonders with an instrument I have made with my hands."

The small dollar telescopes mentioned by the Reverend Mr. Cutler are of little use as a finder because they are of the old Galilean variety, easily recognizable by the outside of the eye lens which is concave. The field of view of a Galilean telescope is limited to about a degree in diameter, while a finder should take in three to five degrees. However, no finder is needed; a simple homemade gunsight with a ring is virtually as satisfactory; or simply aim the tube, as described above.

From another clergyman, Rev. Edwin H. Smith, pastor of the Epworth Methodist Church, 1270 Sanchez Street, San Francisco, California, comes another inspiring communication. "It was my good fortune, about a year ago," he writes, "to learn of the book of instructions, 'Amateur Telescope Making.' The proposition seemed to me altogether incredible, and I think that I would not have attempted the making of such a telescope, had it not come from the SCIENTIFIC AMERICAN.

"I first made a six-inch mirror, and succeeded so well that I proceeded at once to make a ten inch. And now I am simply amazed at three things—the small cost in money; the marvelous powers and perfection of the mirror; and, most of all, the fact that I made it with my own hands. Every once in a while I have to go out and turn the telescope on the moon, or something, in order to satisfy myself that it is not all a dream. And when someone comes



Reverend Smith's second reflector

along and questions the cost of materials, only 20 dollars, I can't feel sure of that either, until I go over the bills and check them up again.

"It was my very great pleasure to take the ten-inch telescope up to Camp McCoy, a Y. M. C. A. summer camp for boys in the Sierra Nevada Mountains. There, at an elevation of 6000 feet, and in the transparent atmosphere of the mountains, the definition, at the power of 170 diameters, was clear, sharp, wonderful, amazing. Another very interesting experience was a visit to the Lick Observatory on Mount Hamilton where one thought troubled me. We were to see the planet Saturn through the big 36-inch refractor and I was wondering whether I should have any respect for my little reflector, after looking at Saturn through that big refractor. Well, good fortune or bad, the night was not the best for 'seeing.' The atmosphere was 'boiling.' So the view of Saturn was not quite clear and only three of the satellites were visible. The result was that I came down the mountain prouder than ever of my little ten-inch telescope."

A small, round observatory dome under construction by B. W. St. Clair, Director of the Standardizing Laboratory of the General Electric Company's laboratory at West Lynn, Massachusetts. The frame of battens is covered with canvas

In addition to the two clergymen whose interesting letters appear above, it is known that several others are at least interested in telescope making, for copies of A. T. M. have been obtained by them.

One rather interesting aspect of amateur telescope making has been the women who have taken it up. Can a woman make a telescope? Well, why not? In the original group of amateurs at Springfield, Vermont, led and instructed in 1921 by Russell W. Porter, there was a woman who made a good mirror. There have also been a number of women purchasers of A. T. M. Here in New York two of these seem to be making out very well, both having brought in their mirrors for our admiration. One took her mirror to "Stellafane" and finished it there.

Mr. Porter reported: "Mrs. W. finished her mirror last night, a very good mirror; the first woman I know of who *thoroughly* understands the knife-edge test, among amateurs." Doubtless the last two words in his statement refer to the fact that a woman telescope maker was for some years

(*Please turn to page* 279)

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Industries from Atoms

(*Continued from page* 268)

market an asphalt emulsion paint to be known as "Asphalt Chromate Emulsion" or "Ace" for short. The incorporation of chromates in the emulsion is an added feature calculated to render metal surfaces "passive" to corroding influences. This action of certain salts has been known to chemists for some time and materials used to render metal less susceptible to corrosion are known as inhibitors.

The new paint therefore permits the deposit of a coating of any desired thickness and at the same time incorporates rust inhibitives throughout the depth of the film. It is applied cold with a brush or spray, can be successfully applied to damp surfaces and will dry in from six to eight hours. The resulting film of asphalt is said to be resistent to extremes of temperature and to be relatively water-proof. The principal use for this protective coat at present is for under-ground piping but experiments in other fields indicate that it will find application in a wide variety of uses.

Profits Squeezed Out of Waste Lemons

AN example of the success which can be attained by the application of research to the problem of agricultural waste is furnished by the citrus fruits industry. The disposal of cull or waste fruits was a pressing problem since it involved not merely a waste of products on which time and labor had been expended but also an additional expense for disposal of the material. Research by the Bureau of Chemistry developed uses for the waste lemons, oranges, and so forth, in the manufacture of citric acid, lemon and orange oils, pectin, and the like. A profit of approximately one million dollars per year was thus realized and the citrus fruit grower, instead of paying a dollar per ton for disposing of his waste material, receives twelve dollars per ton from the by-product manufacture.

Robin Hood's Merry Men Popularize Primitive Dye

IN his pamphlet, one of the Woodbrooke Essays, "A Primitive Dyestuff," Dr. Rendel Harris gives some interesting notes and reflections on the woad plant, the earliest dye-plant known in England. When the art of dyeing with woad became a leading industry, it was the custom to treat the blue dye with an alkaline or ammoniacal liquor or lye, which changed the blue into a vivid green, known to the ancients as lincoln green, such as Robin Hood and his men wore in the recesses of Sherwood Forest. Caesar, in his history of the Gallic Wars, describes the Britons as dyeing their bodies with woad, "a substance that yields a bluish pigment and in battle greatly increases the wildness of their look." Up to a few years ago the woad plant was still cultivated in England but the old race of nomadic woadmen, a kind of agricultural gipsy class, has practically disappeared because of the achievements of modern chemistry in producing better and faster dyes by organic synthesis.

In contrast to the efficient, large-scale production of modern dyes, the description of the old fashioned method of extracting woad is interesting. The woad was cut by women and girls, carted to the farm,

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and ground at once. The mill, worked by an engine, consisted of three large revolving wheels that described a circle, and two running flanges, one on the outer and one on the inner rim of the wheel track that kept the woad in place. The leaves were piled within the circle and pitched under the wheels a little at a time by two men who then brushed all stray leaves on to the track. The crushed woad was put into two wooden vats. A pipe carried away any juice that ran out, as this is not of use. The next day the woad was made into balls by hand; and these balls were laid out on racks where they would stay until the following December. Then all the woad would be packed into casks and sent to Leeds, where it passed into the hands of the dye-merchant and the dyer. The government still insists on certain cloth for its use being dyed with woad; hence the activity of the firm in Leeds.

Chemists Strive for Extreme Low Temperature

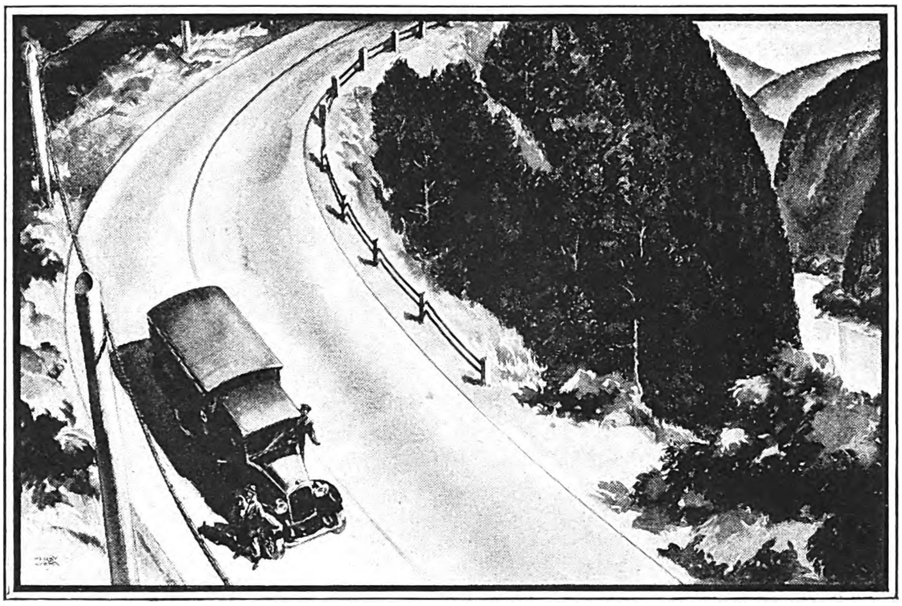
THE efforts of scientists to achieve extremely high temperatures are generally known and have been applied in certain industrial operations. Less is known of the work of another group of scientists who are striving to produce extreme cold. Professor B. S. Hopkins of the University of Illinois recently told the Institute of Chemistry about his attempts to produce "absolute zero," which is 273 degrees below zero, Centigrade. At absolute zero it is believed that the molecules of matter cease entirely the vibration which characterizes them at ordinary temperatures and the character of the substance is thereby entirely changed. Professor Hopkins is attempting to achieve this extreme frigidity by the use of a substance called "galolinium sulfate."

Chemistry is developing the field of "rare earths." Stripping the elements of their technical names—cerium, thorium neodymium—these rare earths are now used in the manufacture of electric light and radio bulbs, cast iron, cigaret lighters, seasickness cures, fine grades of optical glasses for microscopes and telescopes, antiseptic dressings, porcelain and china glazes, and allied lines. The big problem confronting the "rare earth" chemist is that of lowering the temperature to "absolute zero."

Corrosion-Resisting Flooring

WHILE the ordinary concrete floor is long-lived and wear-resisting in most types of factory, it is readily susceptible to chemical attack and disintegration when used in places where there is constant exposure to acid. Thus the foundations of a building may also be attacked in time. A type of flooring is needed which can resist unavoidable spilling of acid and can also withstand heavy loads and hard wear.

Such properties are claimed for Prodorite, a compound for flooring which has remarkable resistance to acid attack. It has, according to a British National Physics Laboratory report, a crushing strength of 6000 pounds per square inch, and possesses a resistance to abrasion double that of matured 2 to 1 sand-Portland cement concrete. At 60 degrees, Centigrade, the material is stated to withstand concentrated hydrochloric acid, 65 percent sulfuric acid, and 15 percent nitric acid. It also resists the above acids at greater concentrations when cold.



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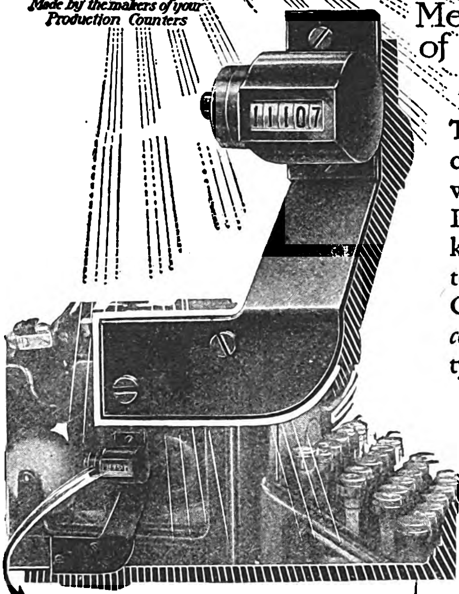

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Synthetic Ammonia Abroad

FOLLOWING Germany's example, the principal French coal mines are developing the utilization of their by-products, with a view to reducing the cost price of coal. Production of synthetic ammonia through the Claude and Casale processes is increasing in France, and 10 mining companies have already started this production, either directly or through branch companies.

The present production capacity of synthetic ammonia in France is said to be between 200 and 225 metric tons daily. This production policy has facilitated the preparation of sulfate of ammonia for agricultural uses, 182,000 tons being produced from all sources in 1927, as compared with 77,000 tons in 1913, according to Assistant Commercial Attaché D. J. Reagan, Paris.

Vanillin From Sulfite Liquor

FOR years, paper manufacturers have sought some practical use for the ill-smelling sulfite liquor that results from the manufacture of cellulose from wood. To imagine this waste product as the source of a sweet-smelling, tasty, flavoring extract seems far fetched, yet reports from Hamburg, Germany, state that vanillin has been produced in considerable quantities from sulfite liquor.

Special Finishes for Aircraft

THE aviation industry, now in its infancy, may be expected to continue its spectacular growth. Likewise, the chemist may be expected to contribute to the development of better fuel and better materials of construction, but no opportunity offers more immediate promise than in the further development of materials and methods of finishing, says R. C. Martin, in a recent issue of *Chemical and Metallurgical Engineering*.

Two distinct types of materials used on the wings and fuselage of airplanes are known as "acetate dope" and "nitrate dope." Whenever the word "dope" is used, it generally refers to a combination of a cellulose derivative blended with the common esters such as ethyl and butyl acetate and solvents like acetone and benzol.

Mr. Martin predicts that airplanes will soon be as attractively finished in colored lacquers as modern automobiles.

Luminous Pressure Waves

PHOTOGRAPHY of the phenomena taking place when a cartridge of dynamite is detonated has shown the existence of luminous waves propagated at high speed in the air surrounding the explosive. It was at first thought by United States Bureau of Mines engineers, conducting these experiments, that these waves were merely reacting gases projected from the explosive, but further work in which the air around the stick has been replaced by hydrogen or carbon dioxide has made it seem probable that these are really pressure waves at such high temperatures that the gas actually radiates in the visible region of the spectrum. The work is part of a program of investigation by the Bureau of Mines of the sensitivity of explosives to detonation by influence.

Can Chemistry Improve on Roast Beef?

A GLIMPSE into future possibilities of industrial chemistry in utilizing agricultural products was given by Dr. C. M. A. Stine, Chemical Director of E. I. duPont de Nemours and Company, speaking before the American Farm Bureau Federation in Chicago. Dr. Stine pointed out that it requires 100 pounds of foodstuffs to produce three pounds of beef, and three acres of land to support a cow, but thousands of pounds of solid yeast protein may be developed and separated in a few hours in a very limited space by growing yeast upon such fermentable agricultural waste as molasses, for example.

"Whether we shall eventually take appreciable amounts of our protein in the form of some product such as a yeast protein instead of beef, I do not know," Dr. Stine declared. "This merely serves to illustrate the tremendous, revolutionary changes which applied science is capable of bringing about in the lives of men. I am sure that if you had told the gas and coke manufacturer of the early days that his troublesome and stinking coal tar, which he had to get rid of, would some day become the raw material for the production of a whole world of colors and drugs and medicinal products, he would have been no less skeptical than you may be today when I talk of the possibility that science, applied to the problems of the best and most economical utilization of land for crop purposes, will evolve new uses for entirely new crops which will automatically take care of a number of our problems today such as the utilization of certain agricultural wastes. The agricultural wastes of today will no longer be produced or will be produced in a much smaller volume."

Making Luminous Paint From Radium

A CASE of radium "poisoning" of employees of a maker of luminous clock dials, et cetera, attracted much notice in the metropolitan press some time ago. The employees affected brought suit for damages on the contention that they were doomed, by radium poisoning, to a slow but certain death. The details of this dramatic litigation were informative to many who never realized that radium is actually used in luminous paint.

Luminous paint is nearly 300 years old, although it was not until after the discovery of radium that permanently luminous paints were made commercially. The material consists fundamentally of a phosphorescent body mixed with a suitable radioactive substance. Zinc sulfide is used for the former and either radium or mesothorium is used as the radioactive substance.

A solution of zinc chloride is prepared from the metal or oxide, purified and then precipitated as sulfide, which is dried and ground. To the dried sulfide is added the copper, the proportion usually being between 1 part in 10,000 or 1 part in 50,000. The copper is added in the form of a dilute solution of copper sulfate. After this addition, the sulfide is again dried and ground. The dried sulfide is next heated to 1300 to 1400 degrees, Centigrade, giving small hexagonal crystals which are rubbed through a sieve without grinding. In incorporation with either radium or mesothorium the tube is opened and the desired quantity mixed dry or added to the moistened sulfide in solution. The mixture is then dried at ordinary temperature, preferably in a vacuum over sulfuric acid. To apply the luminous powder, it is mixed to form a thick paste with a suitable transparent varnish.

The freshly mixed compound does not immediately attain its maximum luminosity, but this increases gradually for a period usually between 10 and 20 days. After this the luminosity begins to fall, at first gradually, then more rapidly and finally gradually again.

Heavy Liquids Used in Ore Testing

HEAVY liquids have come into use in ore-dressing investigations, as they make possible the separation of an ore into its specific-gravity components. Some heavy liquids become discolored after use, and the lack of transparency impairs their value. Since they are expensive, it is desirable to reclaim them. In Serial Number 2897 by R. G. O'Meara and J. Bruce Clemmer, recently issued by the United States Bureau of Mines, Department of Commerce, methods of preparing and cleaning some common heavy liquids used in ore cleaning are discussed. The liquids dealt with are acetylene tetrabromide, methylene iodide, thallium formate, and thallium malonate-formate.

Bacteria Used to Measure Oxygen

TURNING the personal habits of certain bacteria to useful account is an old trick of the chemist. The latest wrinkle in this field however is reported in *Science* which says that by using luminous bacteria as an indicator, the diffusion of oxygen through a membrane may be readily viewed. A test tube is completely filled with a dilute suspension of the bacteria and stoppered. With the insertion of a glass stopper the luminescence disappears completely because oxygen is necessary to produce it. If, however, a membrane be used as a stopper, the bacteria in contact with the membrane or within a short distance of it remain active and glow visibly. A comparison of the luminous columns will give an approximate estimate of the amount of oxygen diffusing through the membrane.

Hazards in Handling Sulphuric Acid in Drums

NEARLY every manufacturer handles sulfuric acid at some time, for it is probably the most universally used chemical. It is generally handled in iron drums and is not ordinarily regarded as an explosion hazard. Not long ago, however, two lives were lost in the explosion of a drum of concentrated acid. The "bung" which had been loosened to provide a vent, corroded so as to seal the hole and the

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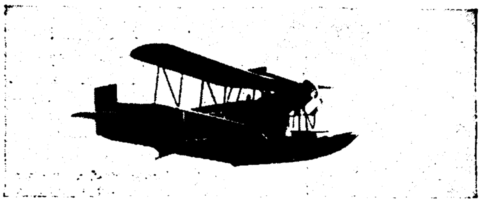

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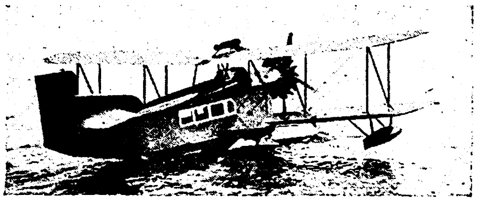

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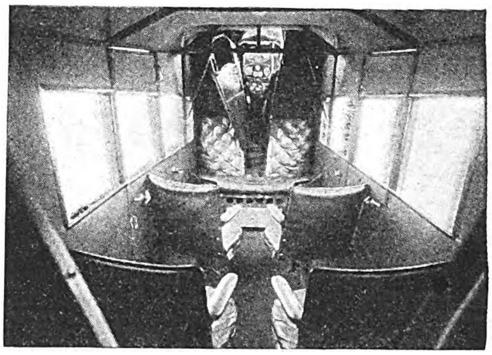

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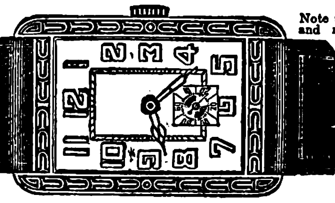

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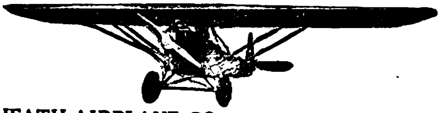

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hydrogen generated by the action of the acid on the iron built up to a pressure which finally rent the welded side of the drum. As a result of the investigation which followed this accident, *Chemical Markets* publishes a warning to users of sulfuric acid as follows:

Sulfuric acid should not be stored in drums, this for the reason that the drums are not of heavy enough gage metal to stand the corrosion that is bound to occur, and in the second place as the reaction goes on between the acid and the iron, a vent, unless it is rigidly inspected, will be sealed up by the sulfite, with the possible result described above.

Chemistry Contributes to Complexions

AMONG the cosmetics that compete for a place on milady's dressing table, a newcomer has recently made its appearance—facial cream that will wash off with water. Let us not pause here to enumerate the manifold blessings conferred by this boon to womankind—the advertisements will cover that phase of the subject fully. Instead let us stick inquisitive noses into the attractive jar and find out how chemistry has provided this new passport to female pulchritude.

It all goes back to that red-letter day in American chemistry when one of our greatest chemical companies decided to venture into the field of commercial synthesis of a hitherto rare series of products from natural gas. From that venture has resulted one of the most remarkable developments in industrial chemistry, the creation of an industry which daily produces tons of compounds that a decade ago were hardly more than laboratory curiosities. One of the latest synthetic compounds built up from ethane gas as a starting point is triethanolamine, a colorless, viscous liquid with an ammoniacal odor, freely soluble in water and strongly basic in nature. This is the secret of water soluble face cream.

The product now available as commercial triethanolamine is, in fact, a mixture containing approximately 70 to 75 percent triethanolamine, 20 to 25 percent diethanolamine and 0 to 5 percent monoethanolamine. It reacts both as an organic base and as an alcohol. It combines freely with fatty acids such as oleic and stearic to form soaps that are readily soluble not only in water but also in gasoline and oil. Small quantities of such soaps will emulsify a mixture of mineral oil and water to yield an excellent cutting oil. Shaving soaps and facial creams that can be washed off with water can readily be produced from the same soaps.

Triethanolamine can replace, in whole or in part, various organic alcohols such as phenol or glycerine in the manufacture of synthetic resins. Small quantities of triethanolamine added to organic liquids greatly increase their penetration into cellular materials such as wood or fibers. This increased penetration results partly from a lowering of the surface tension of the liquid, a property which triethanolamine exhibits in a marked degree. Finally the ethanolamines are among the most hygroscopic organic compounds known. Although monoethanolamine is outstanding in this respect, commercial triethanolamine is far more hygroscopic than either glycol or glycerine.

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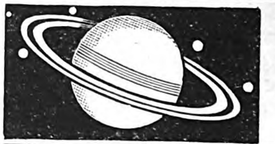

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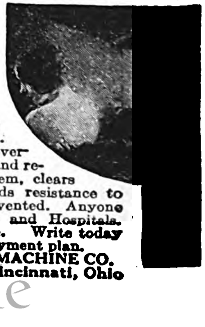

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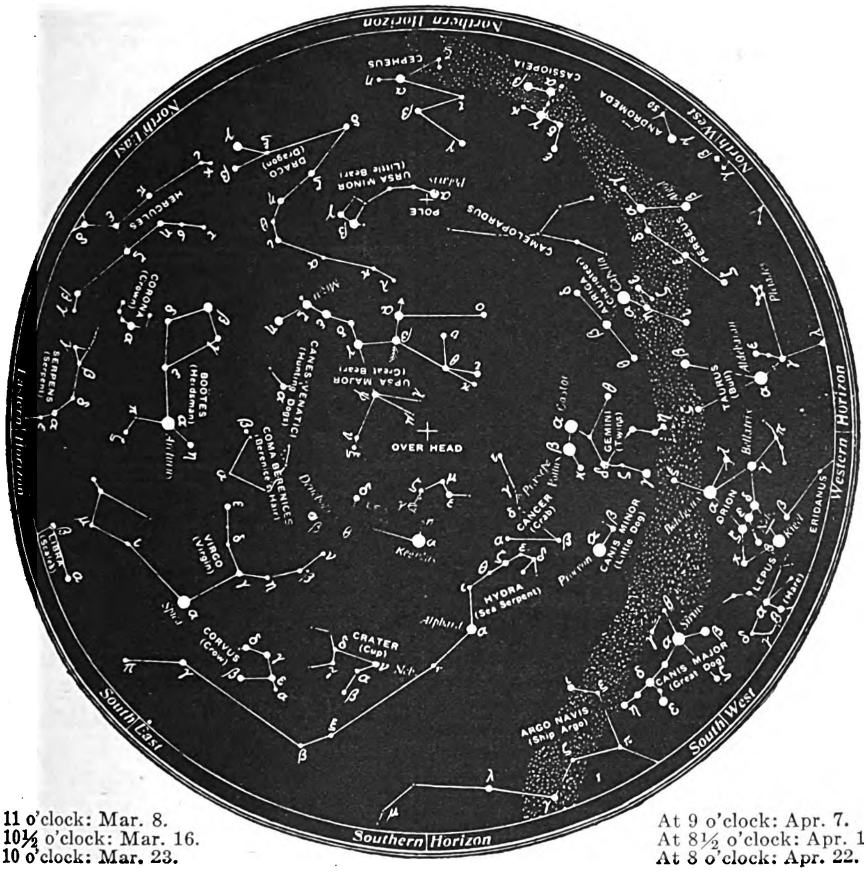
The Backyard Astronomer

(*Continued from page* 273)

employed professionally at the famous Brashear shops in Pittsburgh. It is hoped that those of the amateurs who are not already peeved because women have recently invaded the trades and professions, and ruined the sacred clubbiness of our barber shops, will throw down the challenge to their wives, sisters and others to make a mirror. We would like, say a year hence, to devote the whole Back Yard of one issue to telescopes made by women—they, of course, to appear in the pictures for art's sake.—*A. G. I., Tel. Ed.*

The Heavens in March

By PROF. HENRY NORRIS RUSSELL, Ph.D


Northern Horizon
North East
North West
Eastern Horizon
Western Horizon
South East
South West
Southern Horizon
Cepheus
Cassiopeia
Andromeda
Draco (Dragon)
Ursa Minor (Little Bear)
Pole
Camelopardus
Perseus
Hercules
Corona (Crown)
Auriga (Charioteer)
Capella
Taurus (Bull)
Aldebaran
Pleiades
Serpens (Serpent)
Bootes (Herdsman)
Arcturus
Canes Venatici (Hunting Dogs)
Ursa Major (Great Bear)
Mizar
Over Head
Castor
Pollux
Gemini (Twins)
Coma Berenices (Berenice's Hair)
Denebola
Regulus
Cancer (Crab)
Praesepe
Canis Minor (Little Dog)
Procyon
Betelgeuse
Bellatrix
Orion
Rigel
Eridanus
Lepus (Hare)
Libra (Scales)
Virgo (Virgin)
Spica
Hydra (Sea Serpent)
Alphard
Crater (Cup)
Corvus (Crow)
Sirius
Canis Major (Great Dog)
Argo Navis (Ship Argo)

At 11 o'clock: Mar. 8.
At 10½ o'clock: Mar. 16.
At 10 o'clock: Mar. 23.

At 9 o'clock: Apr. 7.
At 8½ o'clock: Apr. 14.
At 8 o'clock: Apr. 22.

At 9:30 o'clock: March 29.

NIGHT SKY: MARCH AND APRIL

MERCURY is a morning star all through March. He is farthest from the sun (in the sky) on the 5th, being 27° 14′ away; which is the maximum possible distance since he is at his greatest *real* distance from the sun only a week later. He would be conspicuous in the early part of the month if he were not south of the sun; and even as it is he rises before 5:30 A.M and should be easily visible in the dawn.

Venus is an evening star and at her greatest brilliancy. She appears telescopically as a rather wide crescent 40 seconds from horn to horn. This can be seen with a good binocular magnifying ten times or more. To the unaided eye she is 12 times brighter than Sirius and dominates the evening sky, remaining in sight till 9:30 P.M.

Mars has by this time been left far behind by the earth's more rapid orbital motion and is only one sixth as bright as he was when the year began. He is still in Gemini, retracing his path of the last two months pretty closely; but has fallen far to the westward in the sky, so that he is in quadrature on the 28th and is due south at 6 P.M. He is far north and remains in sight until 2 A.M. in the middle of the month.

Jupiter is an evening star and sets between 9 and 10 P.M.

Saturn is visible in the morning and comes into quadrature west of the sun on the 21st. He is, however, so far south that he does not rise till nearly 2 A.M.

Uranus is in conjunction with the sun on the 28th and is practically invisible. Neptune is in Leo just past opposition and will be observable telescopically.

The moon is in her last quarter at 6 A.M. on March 3rd; new at 4 A.M. on the 11th; in her first quarter at 3 A.M. on the 18th and full at the same hour on the 25th. She is nearest the earth on the 17th, and farthest away on the 24th. While on her circuit of the skies she passes by Saturn on the 4th, Mercury on the 8th, Uranus on the 12th, Venus and Jupiter on the 14th, Mars on the 18th, and Neptune on the 22nd. On the 18th she occults Mars, hiding the planet for three quarters of an hour, but the occultation occurs in the daytime for American observers. As seen from Washington, Mars is behind the moon when the latter rises, and comes out at 11:25 A.M., local time, when both are so low that the emersion will be hard to see unless with a telescope.

We may note, finally, that at 9:35 P.M. on March 20th, the sun crosses the celestial equator and "spring begins."

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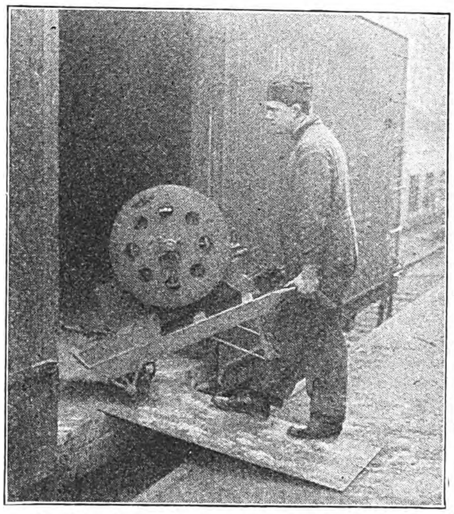
The Scientific American Digest

(*Continued from page* 265)

confined to the lading itself, much in the same manner as one would tie a bundle of sticks together with rope.

Early experiments with Unit-Load, which were made on cylindrical containers such as barrels, drums, newsprint rolls, proved that the idea was sound—even the first shipment was a complete success. The news spread rapidly; the railroads and inspection bureaus got back of it; and today this plan of bracing has been perfected.

Among the products which are now braced in this manner in addition to barrels and newsprint previously spoken of are: strawboard, box board, tin cans, roofing paper, crated materials such as stoves, furniture, lineoleum, and the like, radiators, enamelware, such as bath tubs, lavatories, and sinks, paint products, white and red lead, steel cylinders, milk cans, mixed loads consisting of pails, boxes, cans, et cetera, automobile engines, cold rolled strip steel, sheet steel, fruit boxes, and many others too numerous to list. During 1928 well over 350,000 carloads of freight of all kinds were braced with Unit-Load, and the results are said to have been uniformly satisfactory.



Reels, clamping tools, et cetera, are all carried on a small hand truck

The advantages of the Unit-Load method of bracing are many, both from the standpoint of the shipper, the railroads, and the consignee. Damage is practically eliminated, and the cost of bracing material and time of loading and unloading is greatly reduced.

Illustrations presented with this article afford the reader a fair idea of the principle of Unit-Load and its simplicity, as contrasted to the slow, costly, and notably inefficient practice of blocking with heavy timbers.

Corns and Shoe Trees

"COVERINGS for the feet, and corns" appear to make a combination which man has great difficulty in avoiding. In general the shoe has to be accepted as it is provided for us by the manufacturer. The corn, commonly defined as "horny induration of skin from pressure" follows as an adaptation response of the foot to the shoe. Since it is pressure and friction that cause the difficulty, some special provisions should be made to avoid these and so to obviate, if not the corn, at least its

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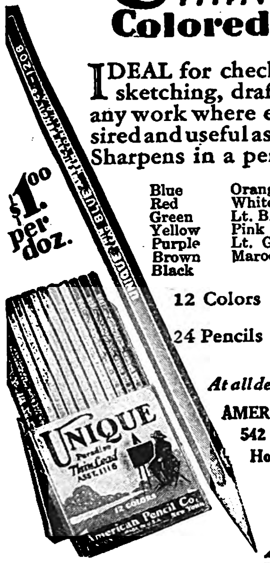

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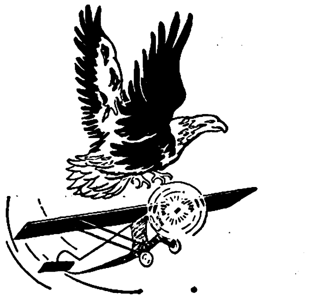

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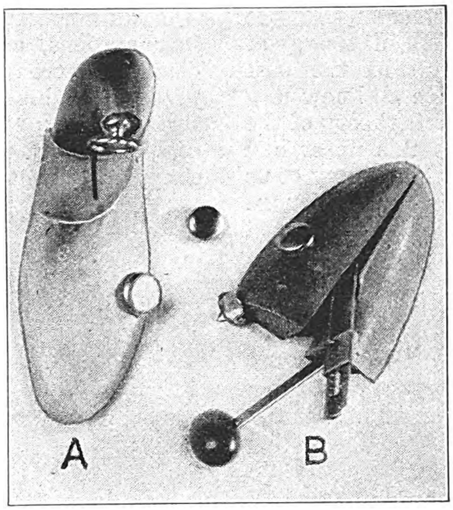

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The small metal sliders are sold under the name of "Domes of Silence." It is very easy to locate a number of these at the proper spots. Handling the matter in this way obviates the necessity of stretching the shoe in the customary way which is often done almost to the breaking point, and furthermore the shoe need not be disfigured. The leather becomes accustomed to the modified shape of the improved shoe-tree and if the tree is placed in the shoe regularly every night, the individual may experience very great relief. In some instances the corn has been observed practically to disappear under these conditions.

"Saratoga" Is Now World's Fastest Large Ship

FOLLOWING the announcement made during November that the United States airplane carrier *Lexington* had developed, in a test run, a speed of 34.82 knots, a recent report from San Pedro, California, states that the *Saratoga*, sister ship of the *Lexington*, has exceeded this record. The *Saratoga* achieved a rate of 34.99 knots, or approximately 40.5 miles per hour.

In order to develop this speed for a vessel of such great weight (33,000 tons), the General Electric motors had to supply 215,581 horsepower to the propeller shafts. It is estimated that, at this rate of speed, it would be impossible to stop the ship in a distance of much less than a mile.

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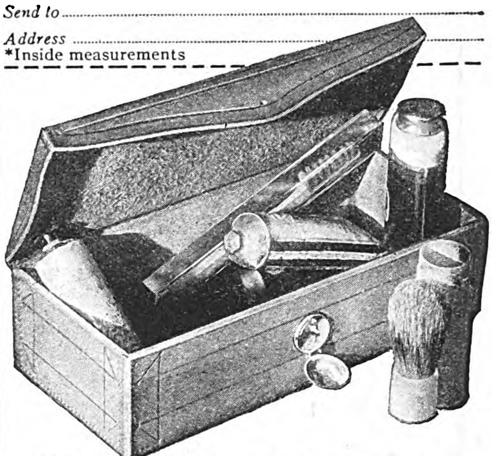

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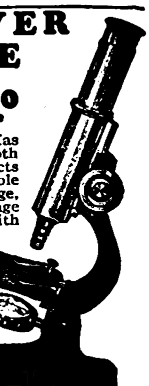

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SCIENTIFIC AMERICAN

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

The Patent Office Falls Behind

THIS department heretofore has called attention to the increase in the number of patent applications and the accompanying *decrease* in the number of patents issued. Many explanations have been offered, one of them being the theory that the margin between the things we know and the applications we have made of our knowledge rapidly is narrowing. In other words, within the limits of our knowledge there are fewer things left to invent.

These are the figures which seemed to need an explanation:

YEAR	APPLICATIONS	PATENTS
1926	80,682	46,464
1927	84,511	43,244
1928	88,482	41,067

The following figures throw a flood of light upon the situation:

APPLICATIONS AWAITING ACTION	
1926	43,765
1927	64,646
1928	106,575

The real explanation, then, seems to be simply that the Patent Office cannot keep up with the enormous volume of cases which it is called upon to handle. The more applications it receives, the further behind it drops, and the fewer patents it issues. For the sake of the inventors of the country and the industries affected by their work, something should be done about it.

The fault lies not with the efficient and conscientious, but over-worked staff of workers in the Patent Office, but with Congress for failing to provide adequate funds. Commissioner Robertson stated:

"The work of the Patent Office may be divided into two classes—one, the usual clerical work, and the other, the technical, scientific work performed by the examining corps. As will be hereinafter shown, the work of the 600 clerical employees is practically up to date, but the scientific, technical work in the 56 patent-examining divisions is not and can not be kept current when it keeps on increasing year by year as it has, unless the force of technical examiners is correspondingly augmented. Thus, in 1925, excluding design and trademark cases, the office received 77,000 applications; in 1926, 80,000 applications; in 1927, 84,511 applications; and in the year just closed 88,482 applications. Notwithstanding this great increase of work, our force of examiners has been smaller than in 1925.

"To add to the increase of work as above specified, the law was changed about a year ago to provide that applicants must amend their applications after official action thereon within six months instead of a year as formerly, and this has vastly increased the work. This, added to the 3000 more new applications, has resulted in the reciept of from 800 to 1000 cases per week more than the personnel could handle, with the result that while there were 64,646 patent applications awaiting official action one year ago, that number has grown to 106,575, a point never before reached in the history of the Patent Office. Moreover, the receipt of this vast amount of business has resulted in the examiners going further behind in their dates. Thus, two years ago when our force of examiners was 50 larger than now, a number of the divisions of the office were acting on cases within two months after they were filed, with an average of two and one half months; a year ago it was three and one half months, and now the average has reached six months. This condition should not be permitted to continue.

"The Bureau of the Budget and Congress have come to our relief by providing for the coming year six new divisions, with 80 additional employees. The Public Buildings Commission has also relieved us by providing additional space in the old Land Office Building to house these additional employees. By the time these employees become trained as many more will have resigned and their places been filled by green men, so it will not be possible to make much impression on the mountain of work now piled up. With more than 106,000 cases awaiting official action, there is sufficient work on hand to occupy the entire force for a year even if no work were received, but the new work in unprecedented amount keeps coming in and must be taken care of."

Safety in Secrecy

IF you have a valuable invention, don't let the knowledge of it escape until you have applied for a patent. Don't use it publicly; if it should be in public use for two years before you apply for your patent, the government cannot under the law grant you a patent, even though the fact that you are the sole and original inventor may be indisputable.

How important proper safeguards to insure secrecy may be was illustrated recently in the infringement suit brought by the Peerless Roll Leaf Company, Inc., against H. Griffin and Sons Company. The purpose of the patented machine was to feed metallized transfer strips of paper to a stamping press for use in printing titles upon book covers. There had been other such machines before, but the patent in suit, Number 1,526,209, was for an improvement.

The Griffin company appeared with a machine invented by Richard Lange, but which was said to infringe the Grupe claims. When the case came to trial the Griffin company showed that an associated company of the Peerless company, the Ebees Company, had made three machines embodying the invention more than two years earlier than March 31, 1924, the date of the application for the patent. These machines had been turned over to the Sterling Company, another associated organization, which used them commercially during 1921 and 1922. Upon this point there was no dispute.

The Sterling Company, however, was careful not to let the public know how the machines were being used. They were not sold, nor were they displayed to any persons who came to the factory. Only three employes were admitted to the room where they were kept, one Mangold, who was in charge of them, with the aid first of one,

Many inventors, who cannot afford to advertise, display their devices for sale on the boulevards of Paris during the Christmas holidays. This picture shows an inventor demonstrating his bottle opener to prospective purchasers. The Prefect of Police grants permission to set up the stands every Christmas and later of two, assistants. The plaintiff was "right secretive about them," "partitioned the machines off in a little room on the floor" and kept them secret "by isolating them." Access to them was possible only by crossing a bridge between two buildings. Moreover, the Sterling Company was an experimental department of the Boucher Company, and it was to test out the product that the Sterling Company used them. On the other hand they were used to ornament paper boxes and the like, which were shown freely and sold in quantity. Customers for the products were not, however, shown the machines themselves.

In deciding that the invention had been kept a secret and that, therefore, the patent which was infringed, was a valid patent, Judge Learned Hand, of the Circuit Court of Appeals for the Second Circuit, said:

"The word 'public' means more than that the use shall not be experimental; it is possible, even after the time of experiment has passed, to practice the invention without abandonment. An inventor working by himself presents a simple case, but we cannot suppose that his rights are greater than those of a company. There must be some way by which they can privately practice their inventions as well as he, and yet any practice involves the knowledge of some employes.

"When the number of these is limited to as few as are necessary to practice it at all, the customers and the public generally are excluded, and adequate precautions are taken to prevent dispersion of the knowledge until at least two years before application is made, it seems to us enough, whether a formal pledge of secrecy be exacted or not. Those workmen who will keep it do not need it; those who will not, it will not bind.

"We do not mean that if in fact knowledge leaks out, the invention may not be lost; as to that we say nothing. But when, as here, adequate means are taken to confine all information as closely as is consistent with any exploitation at all, and when so far as appears they are successful, the knowledge of the necessary workmen not explicitly pledged to secrecy does not make the use public. The sale of the product was irrelevant, since no knowledge could possibly be acquired of the machine in that way."

Another "Emergency" Case

THE Government and the courts are still untangling patent snarls caused by the World War and in the process new interpretations are made of the rights of inventors. The circumstances surrounding the claim of Carl G. Allgrund against the United States provide an interesting example.

Allgrund is a skilled machinist. For more than 16 years he occupied a responsible position with the Bethlehem Steel Company in its gunshop department and had personal charge of tool making, sights, rifle heads, and so on. In June 1917, he became superintendent of the gun-finishing department of the Symington-Anderson Company of Rochester. This company was at that time manufacturing guns for the government.

Guns had to be made in a hurry in those days and any invention that speeded up their manufacture was valuable. Allgrund conceived the idea of inventing a tool which would facilitate the performance of the rifling operation, would improve it in the way of accuracy, and would do this in less time and at less expense. He showed the drawings to his employer, who authorized an expenditure of 500 dollars to develop it. By February 1, 1918, the newly invented tool was put in operation and thereafter all the guns of the company were made with it.

On February 23, 1918, Allgrund applied for a patent, his employers disavowing any claim to the invention. On June 29, 1918, the Commissioner of Patents rejected all the claims in the patent application and followed this action on July 2, with a written injunction of secrecy, saying, "Your application has been found to contain subject matter which might be detrimental to public safety or assist the enemy in this present war." The Federal Trade Commission followed with a similar secrecy order.

But Allgrunn wanted his patent; he made amendments to his application. This time the War Department sought to intervene by filing a petition to take testimony to show prior public use of the invention. Then the war ended, the secrecy orders were rescinded, and on July 22, 1919, Allgrund's patent issued. Meantime, however, four large gun manufacturers, authorized by the government, had been using Allgrund's invention. He made a claim on the government for royalties.

In upholding Allgrund's claims, Chief Justice Booth of the Court of Claims, declares:

"Secrecy is enjoined upon the patentee. We have found the secrecy order to have been observed. The patentee discovers that his invention has become known to and is in use by government contractors other than those who have permission to use it; he at once notifies the government of this use and at the same time tenders his invention for use. The government contractors thereafter continued the use of the invention. Surely opportunity was afforded the government by the tender to discontinue its use. It was but a formal matter for the government to notify the contractors of plaintiff's tender and claims. On the contrary, with full knowledge of the situation, the government at no time did more than to attempt after use to prevent the granting of plaintiff's patent.

"The officers of the government knew the law and were conscious of the legal consequences of using the invention if they continued to use it. What were those consequences? One at least was a liability to compensate the patentee for the use of his invention from the date of the use. The government may not disclaim knowledge of the invention, nor of the plaintiff's future intention to seek compensation. The plaintiff had permission to use the invention and disclose it to his employers and one other company. Therefore it seems to us that the authorized use preceding the tender, if continued after the tender, brings the plaintiff within the relief intended by the act."

Patents Recently Issued

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Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

SUPPORTER FOR WEARING APPAREL—Which permits free bodily movement without injury to the clothing or discomfort to the wearer, and obviates the use of elastics, adapted for hip boots and children's hose. Patent 1694735. James T. Eskridge, La Jara, Colorado.

Designs

DESIGN FOR A DRINK STAND—Patent 76896. Peter E. Ryerson, c/o Imperial Valley Concrete Co., Holtville, Calif.

DESIGN FOR A SHOE—Patent 77082. Leo J. Fitz Harris, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A VALVE FITTING—Patent 77028. Emil Price and William A. Pfister, 2929 Humboldt St., Los Angeles, Calif.

DESIGN FOR A GOBLET—Patent 77227. George Dougherty, c/o Economy Glass Co., Morgantown, West Va.

DESIGN FOR A VEGETABLE CABINET—Patent 77233. Max Halpert, c/o M. H. Metal Product Co. 1154 Flushing Ave., Brooklyn, N. Y. Attention G. T. Latimer.

DESIGN FOR A LAMP STANDARD—Patent 77245. Joseph Lieberman, 39 W. 22 St., Bayonne, N. J.

Electrical Devices

INSULATING SUPPORT FOR ELECTRIC RESISTANCE HEATING ELEMENT—So formed as to prevent over heating of the heating element, and at the same time to induce a circulation of air which promotes a freer radiation. Patent 1695234. Louis J. Fuller, c/o Duparquet, Haut & Moneuse Co., 108 W. 22 St., New York, N. Y.

RECTIFYING SYSTEM—An electric system especially designed for eliminating alternating current hum, rendering the spark gap conductive during only one-half of the cycle of the supply line. Patent 1694837. Fletcher L. Walker, Jr., Westwood, Calif.

Of General Interest

WATER COOLER—Employing a supporting olla, the olla and bottle being sealed against air entering either receptacle except in a manner to be filtered of its impurities. Patent 1692066. Arthur L. Washburne, 4516 York Blvd., Los Angeles, Calif.

REFUSE RECEPTACLE—Having a removable flexible container adapted to receive for temporary storage waste paper or other refuse deposited into the container through a cover movably mounted. Patent 1692287. Samuel D. Bundy, 361 East Alvarado Ave., Pomona, Calif.

SAFETY RAZOR—Which may be produced at a comparatively low cost, the novel features of construction resulting in a saving of material, and very narrow blades being required. Patent 1694337. Jacob Oberheim, 1753 3rd Ave., New York, N. Y.

PROCESS OF FORESTALLING LEAKAGE IN CONCRETE RESERVOIRS—Which consists in subjecting the walls to violent contraction by the application of ice water, with resultant separation of the weak places, and subsequently filling the cracks. Patent 1693094. Eugene R. Oden, c/o Waterproof Paint Co., North Hollywood, Calif.

Means for Sealing Expansion Joints—In concrete reservoirs, by filling the joint with a relatively soft and non-hardening compound, waterproofing the filling, and covering the joint with asphalt, pitch or the like. Patent 1691402. Eugene R. Oden, North Hollywood, Calif.

Manicuring Implement—A three-in-one device which takes the place of the cotton wad, rosewood stick and cuticle bottle, also having means for supplying liquid medicaments, yet compact in form. Patent 1694336. John R. Neidig, Conrad, Mont.

Inlet Box—For chutes in houses, apartments, etc., which will prevent the escape of odors, and will operate to close the chute when the inlet box is opened. Patent 1694347. Harold D. Symonds and Harry J. Cullen, 278 W. 150th St., New York, N. Y.

Building—A fire resisting construction for garages, schools or other purposes, wherein alternating floors are disposed at half-story intervals, and the ramps or stairs are enclosed by walls. Patent 1694309. Charles W. Buckham, 551 5th Ave., New York, N. Y.

Umbrella Rib and Spreader Structure and Method of Producing the Same—Comprising hinging an end of one sheet of material to a medial portion of another sheet of material and longitudinally cutting the sheets to produce rib and spreader units. Patent 1693948. Frank Fabbrin, c/o Continental Products Co., attention Mr. Miller, 149 Broadway, New York, N. Y.

Cosmetic-Pad Holder—Wherein the bottom of the pan-shaped holder is formed with indentations presenting retaining means for resiliently supporting the pad. Patent 1694325. William G. Kendall, 118 Market St., Newark, N. J.

Lamp-Shade-Frame Holder—Adapted to be incorporated in and become an integral part of the wire lamp shade frame so that a lasting connection may be obtained. Patent 1695223. Kornel C. Berger, 365 First Ave., New York, N. Y.

Box—A relatively fragile box, constructed of light cardboard, or paper, and reinforced for holding sheets of material so that they may be readily manually removed. Patent 1695143. Benjamin. L. Drapeau, c/o Standard Abrasive Co., 449 Pacific Ave., Jersey City, N. J.

Tooth Cleaner—A support for holding thread dental floss or other material for thoroughly cleaning between the teeth and removing particles which cannot be dislodged by the brush. Patent 1695238. Godel Kalenoff, 1428 56th St., Brooklyn, N. Y.

Vapor Extractor—To be applied upon towers in combination with the parts used for the extraction of gases and vapors from liquids, and the distillation of liquids. Patent 1695192. Meinhard H. Kotzebue, 1526 So. Victoria St., Tulsa, Okla.

Shingle—Which may be cut from a roll of roofing, having interlocking slits, which assure against curling, warping or other stresses, and requiring a minimum of securing elements. Patent 1696120. James E. Hooker, 311 Barnett National Bank, Jacksonville, Fla.

Combined Water Bag and Food Cooler—Constructed of flexible material with a double wall arrangement, the space being filled with water performing the functions of a cooler and drinking water supply. Patent 1696138. John W. and Harold K. Day, Box 870, Pocatello, Idaho.

Ship—Equipped with devices which will not only result in saving lives, but will carry buoys for facilitating the location, and guide the lifting lines to the ship, if submerged. Patent 1696053. Jerome Pasini, 94 Baxter St., New York, N. Y.

Wall Louver Ventilator—A metal and wire screen device adapted to be readily inserted in a wall; particularly for the ventilation of cold

When Does Depreciation Start?

The older a patent is, the less it is worth. Each year of its life it is worth less than the year before, because it has one year less to run. But what of an application for a patent?

A patent application is an assignable property right, capable of having a definite value placed upon it, just the same as a patent. The value of an application, furthermore, constitutes evidence of the value of the stock of the corporation for which the rights in the corporation were exchanged. Does, then, the patent application depreciate in value as time goes on, just as the patent does? The Hershey Manufacturing Company thought so, but the Board of Tax Appeals thought otherwise recently, when the Hershey company sought to recover a portion of its tax.

Back in March, 1919, O. S. Hershey, a machinist and tool maker, conceived an idea for a theft-proof automobile lock designed to be secured to the steering column within easy reach of the driver. It was a distinct improvement, for the driver could lock the gears without shifting his position, and the car could not be stolen by means of towing.

Hershey applied for a patent and with his brother and some friends formed a corporation. Three hundred locks were made and they sold readily at six dollars each. The Denver representative of the Cadillac Motor Company bought 25 to put on the cars he sold. Salesmen took orders for 600. The list price was 12 dollars per lock, with 50 percent off to jobbers. Everything considered, the net profit on each lock was estimated to be one dollar. The Underwriters Laboratories approved the lock as entitling owners whose cars were equipped with the device to a 15 percent reduction in insurance rates.

Automobile production was on the increase and it was estimated that 1,000,000 locks easily could be sold in the next ten years. A half million dollar corporation was formed; the rights in the patent application, which still was pending, were estimated to be 250,000 dollars. The patent application was the company's one big asset.

Orders began to pour in and the expectations of the incorporators were far exceeded. The first quantity order came in 1920; it was for 25,000 from the Simplex Corporation, and the net profit amounted to $1.75 instead of a dollar. Automobile manufacturers were approached and they began to adopt it as built-in standard equipment. By 1924 it was standard equipment on models of the Studebaker, Paige, Buick, Lincoln, Chevrolet and Jordan. In eight and a half years the Hershey company sold 2,500,000 locks, built its own factory and reached an output of a million locks a year.

In the beginning, when the rights in the patent application were exchanged for stock, they were estimated as 75,000 dollars. When the corporation was making a report for tax purposes in 1922, it claimed depreciation on account of the Hershey patent in the amount of $8,578.43, of which only $61.22 was allowed. In 1923 the depreciation deductions claimed amounted to $14,705.88, all of which was disallowed. The Hershey company appealed to the Board of Tax Appeals.

In refusing to allow the claim, Judge Siefkin declares:

"While it is very common today for assignments of inventions to be made prior to issue of the patent therefor, strictly speaking, an invention is not an assignable monopoly until its ownership is fixed. The only method of establishing a *prima facie* ownership is by obtaining a patent.

"It is elementary that an asset which has no definite period of useful life is not the proper subject of exhaustion, as one of the essentials to measuring the deduction is unknown. The period covered by application pending is a variable factor. Furthermore, the date the patent issues marks the beginning of the asset in use in an enforceable right, as well as fixes its life. It follows that the inchoate right represented by a patent application matures into a depreciable asset beginning with the date the patent is issued and extending over the 17-year period covered thereby."

Royalties at Last

To Rufus Rand, builder of the new 25-story skyscraper in Minneapolis, we take off our hat. Announcement is made that, without obligation of any kind, he is paying a royalty to Leroy S. Buffington, inventor and patentee of the steel skeleton type of building construction. Buffington's patent was issued 41 years ago; it expired 24 years ago.

Buffington, educated in Cincinnati as a civil and mechanical engineer, went to Minneapolis in 1873, where he designed many public buildings, including 42 hotels, buildings at the University of Minnesota, the old State Capitol, the Pillsbury flour mills, the Union Station in St. Paul and the Boston Block. In 1880 he began to make drawings for what he called a cloud-scraper. In these, a masonry veneer was supported at each successive story on an iron shelf. This is the structural difference between the modern skyscraper and the old-fashioned type of building.

Two years later Buffington drew his first perspective of a 28-story cloud-scraper and in 1887 filed his application for a patent. On May 22, 1888, patents were issued in the United States, England, Germany, France and other countries. Later he formed the Buffington Iron Building Company to further the interests of the Buffington patent. Others began using the Buffington method and in 1894 suits for infringement were begun. Lawsuits, however, have a way of dragging on and on and before they terminated the inventor had spent 30,000 dollars in their prosecution and the patents expired.

All Buffington asked for the use of his system of buildings was a royalty of ⅛ of 1 percent, but nobody ever paid it. His sole reward seemed to be the knowledge that he had advanced civilization by his invention. Three years ago Rand, the grandson of a friend of Buffington, planned to erect a skyscraper. He had heard of the inventor, and, although he had never met him, resolved to pay him a royalty of ⅛ of 1 percent on the 1,800,000 dollar building he was planning. This would amount to just 2250 dollars.

When announcement was made recently that the check was forthcoming, the inventor could hardly believe his ears. Forty-eight years ago he had been called a crank and a dreamer. When architects and builders recognized the value of his method they wriggled out of paying. Now, when he is over 89 years old, when there is no legal obligation of any kind, his first royalty check appears.

closets, bath-rooms, or the like. Patent 17164. (Re-issue.) Robert J. Miller, 2519 11th Ave., Oakland, Calif.

Loose-Leaf Binder—Which comprises a pluralty of wires fashioned into separate split rungs to grip more firmly when stress is applied, and to prevent accidental opening of the rings. Patent 1694846. Frederick A. Diestelkamp, Lowell, Oregon.

Jar Cap—Which may be detachably associated with the neck of a mustard or other container so that it may be removed, cleaned, sterilized and replaced at intervals. Patent 1696719. August A. Lundeen, Lynbrook, L. I., N. Y.

Frame for Photographic Films—Comprising a frame, the longitudinal and end members of which have marginal flanges for receiving, guiding and holding an individual cut film, and retaining the same flat. Patent 1695644. Merle F. Faber and Joseph Kusber, c/o M. F. Faber, 14 Gambetta Ave., Daly City, Calif.

Despensing Faucet—Including means for forming an opening in a container, and sealing the faucet in said opening, while allowing for removal when contents of container are completely dispensed. Patent 1696687. Martin Narbo, 5317 Seventh Ave., Brooklyn, N. Y.

Mold-Form Structure—A corner mold-form by means of which concrete or other plastic material may be shaped to form wall structures, and means for alining abutting sections. Patent 1696700. Harold R. Suiter, c/o Concrete Form Co., 326 Mt. Vernon Ave., N. W., Grand Rapids, Mich.

Golf-Club Carrier—Which is lighter than the ordinary bag, is open, therefore preventing the accumulation of dirt, and in which the clubs are independently supported, and balls carried. Patent 1696062. Lewis K. Thurlow and John P. Agnew, 1181 East 19th St., Brooklyn, N. Y.

Hardware and Tools

Grinding Tool—Having a plurality of radially movable grinding elements which are adapted to be controlled in their movement by a spring connected with a cam shaft. Patent 1693778. Louis Engman, 1723 3rd Ave., Moline, Ill.

Bitt—Formed of any suitable metal, for application to a boat or wharf, whereby a rope or line may be readily secured without the necessity of knots or hitches. Patent 1694312. James H. Clark, Room 1771, Woolworth Bldg., New York, N. Y.

Hanging Device for Screens—Adapted for supporting and securely holding a window screen in position, maintaining the screen snugly in engagement with the frame, and preventing rattling and displacement. Patent 1695764. Russell S. Holcomb, 3126 West Ave., 32d, Los Angeles, Calif.

Tool for Cutting Valve Seats—Which may be disposed in a vertical position, or at an angle to the vertical, for cutting valve seats, and providing countersunk pockets to receive the seats. Patent 1693767. Sylvester Smith, 917 Main St., Reedley, Calif.

Combination Tool for Well-Drilling Operations—Adapted for use in recovering lost tools, or other objects from a well, and for cutting off irregular ends of tools or pipes, to facilitate their recovery. Patent 1693789. George F. LeBus, Electra, Texas.

Portable Bench Saw—Which includes a supporting unit and an adjustable power unit, will perform a variety of functions, will occupy but small space, and can be conveniently transported. Patent 1695188. Fay M. Henkel, 16 Stenvenson Blvd., New Rochelle, N. Y.

Tuning Hammer—Which provides sufficient leverage to turn a pin without flexing it, and facilitates the ease with which a pin can be adjusted to accurately tune a piano string. Patent 1693292. William Frauenberger, 2260 Glendale Blvd., Los Angeles, Calif.

Latch—Of simple and durable construction, readily applied to a closure and its frame, and quickly convertible from a latch to a "night latch," or vice versa. Patent 1693912. Walter E. Worthen, 8106 Norton Ave., West Hollywood, Calif.

Pipe Coupling—In which all screwed or threaded connections are eliminated, and will serve the purpose of a suction pipe, for use in connection with rotary drill outfits, without leakage. Patent 1696134. Harry D. Algyre, Box 476, Holdenville, Okla.

Composing Stick—In which the stop may be adjusted for designating the number of picas, and any number of points which divide the picas into equal parts. Patent 1693105. Walter C. Bignold, 428 8th Ave., San Francisco, Calif.

Heating and Lighting

Heating Apparatus—An electric heating device removably positioned for transmitting heat for heating water within the boiler for hot water or steam radiator systems, without a coal or oil furnace. Patent 1696078. Joseph De Ruvo, 2347 Prospect Ave., Bronx, New York.

Apparatus for Projecting Light—Particularly a beam of light for theatrical, dental or surgical uses, and for illuminating fields of given shape and size, on works of art, advertising, etc. Patent 1695556. Harold A. McGunnigle, c/o Artlike Co., 739 Madison Ave., New York, N. Y.

Machines and Mechanical Devices

Loader—Adapted to be removably connected with a truck, and to be actuated by forward or rearward movement of the truck for the loading and dumping of material. Patent 1694344. Joseph J. Koelbel, 219 S. Grand Ave., Baldwin. L. I., N. Y.

Combined Coal Stoker and Burner—Which forces air downwardly upon the fuel in the fire box, means being provided to feed the fuel to the burning area through an automatic stoker. Patent 1694290. John C. St Clair, 313 St., Granite St., Butte, Mont.

Liquid-Dispensing Container—Having a leak-proof-pouring spout cooperating with the closure discharge opening, and seating within the container when not in use, but projecting therefrom for pouring. Patent 1694304. George J. Armstrong, Maple Creek, Sask., Canada.

Rotary Pump—A simple construction which may be placed in an oil well for bailing the water and removing mud from the hole without setting the usual casing. Patent 1694329. John E. LeBus, Electra, Texas.

Cash-Fare Manipulator—A simple and reliable device for compactly housing a book of tickets, with means for neatly removing portions of the tickets, to indicate the amount of fare paid. Patent 1694285. William D. Scalf, Pineville, Ky.

Gas-Main Stopper—Comprising a collapsible and expansible diaphragm and frame, adapted to be passed through an opening in a gas main and expanded to cut off the flow of gas. Patent 1695187. Patrick Goodman, 523 Atlantic Ave., Brooklyn, N. Y.

Oil Saver—Adapted to be associated with the drain opening in the bottom of a tank for saving the lower oil, without permitting the sediment to mingle with the oil. Patent 1694471. Norbert J. Jacobi, Box 143, Electra, Texas.

Bed Attachment—In the form of a mechanism which not only permits the occupant to raise himself to a sitting or inclined position but to elevate and flex the legs. Patent 1693320. Turner B. Smith and James E. Bixler, 101 East Anaheim, Wilmington, Calif.

Sand-Tester Pump—In which no rods or lines are employed for removing the sand for testing, the pump maintaining sufficient suction for removing the mud and water from the sand. Patent 1696096. George F. LeBus, Electra, Texas.

Machine for Casting Curved Stereoplates—In which a cock is used to control the flow of molten metal, and which provides for reducing the distance between the matter and the edge of the plate by a novel arrangement of the cock bearing. Patent 1694299. Carl Winkler, Bern, Switzerland.

Medical and Surgical Devices

Pad and Bed Vessel—In which the cushion is presented to support certain parts of the patient's body without discomfort, the pad and vessel are easily connected and disconnected. Patent 1695160. Amelia C. Sherran, 56 Menahan St., Brooklyn, N. Y.

Prime Movers and Their Accessories

Carburetor—Which may be fed, if necessary, from a fuel tank directly below it, and wherein the liquid fuel is caused to change its direction while in the presence of moving air. Patent 1696711. Frank C. Givens, Clara B. Givens, Administratrix, Box 666, Tuolumne, Cal.

Signaling Device—For use in internal combustion engines, to automatically and visibly indicate when, for any reason, the water ceases to flow through the cooling system. Patent 1693309. Arthur L. Mettler, Route 1, Box 32, Somita, Calif.

Pertaining to Vehicles

Swiveled Axle for Motor Cars—Which prevents wear of pneumatic tires due in ordinary services, to the movement to and from each other of the wheels connected by the usual parallelogram system. Patent 1694305. Enrico Ascarelli, c/o Barzano & Zanardo, 9 Via Due, Marcelli, Rome, Italy.

Adjustable Seat for Automobiles—Which may be adjusted toward or away from the foot and arm operated instruments, such as the pedals and steering wheel, to suit the driver's bodily dimensions. Patent 1693120. William J. Rhyner, Box 153, Salinas, Calif.

Apparatus for Cleaning and Polishing Automobiles—A revolving platform which will permit a plurality of automobiles to be successively introduced to, and selectively discharged from, the point of treatment, for exterior or interior cleaning. Patent 1694120. Bee K. Gillespie, 231 So. La Salle St., Chicago, Ill.

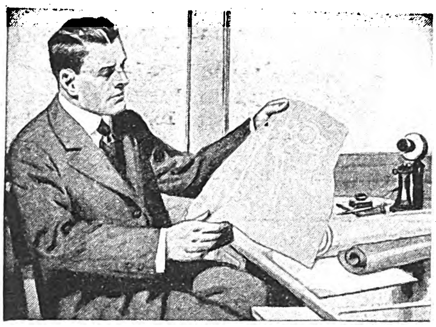
Electric Signal-Transmitting Switch—For the direction indicators of motor vehicles, whereby the intended signal may be set in operation and held for a determined period, whereupon it is automatically rendered inoperative. Patent 1695148. Dewey L. Harrison, 2015 Maryland St., Dallas, Texas.

Mudguard for Motor Vehicles—Characterized by a screen consisting of a rigid portion maintaining at its lower edge a flexible member, and springs serving to maintain the mudguard in middle position. Patent 1695247. Henri Dedisse, c/o Office Picard, 97 Rue St., Lazare, Paris, France.

Automobile Door Pocket—Which can be built into a door as a permanent part thereof, and is characterized by providing for quick accessibility for placing in, and removing articles therefrom. Patent 1694855. George C. Irons, 2367 Second St., La Verne, Calif.

Measuring and Dispensing Receptacle—For use in servicing automobile crankcases with lubricating oil, whereby the flow may be controlled, and the liquid measured as it is dispensed. Patent 1696079. Charles B. Doolin, c/o Mohawk Tire Supply Co., 212 Dallas St., San Antonio, Texas.

Resilient Wheel—Presenting the general appearance of a pneumatic tire while actually being formed of a series of overlapped segments resiliently supported on the body of the wheel. Patent 1695629. Jack Allen, c/o Stern, 2165 71 St., Brooklyn, N. Y.



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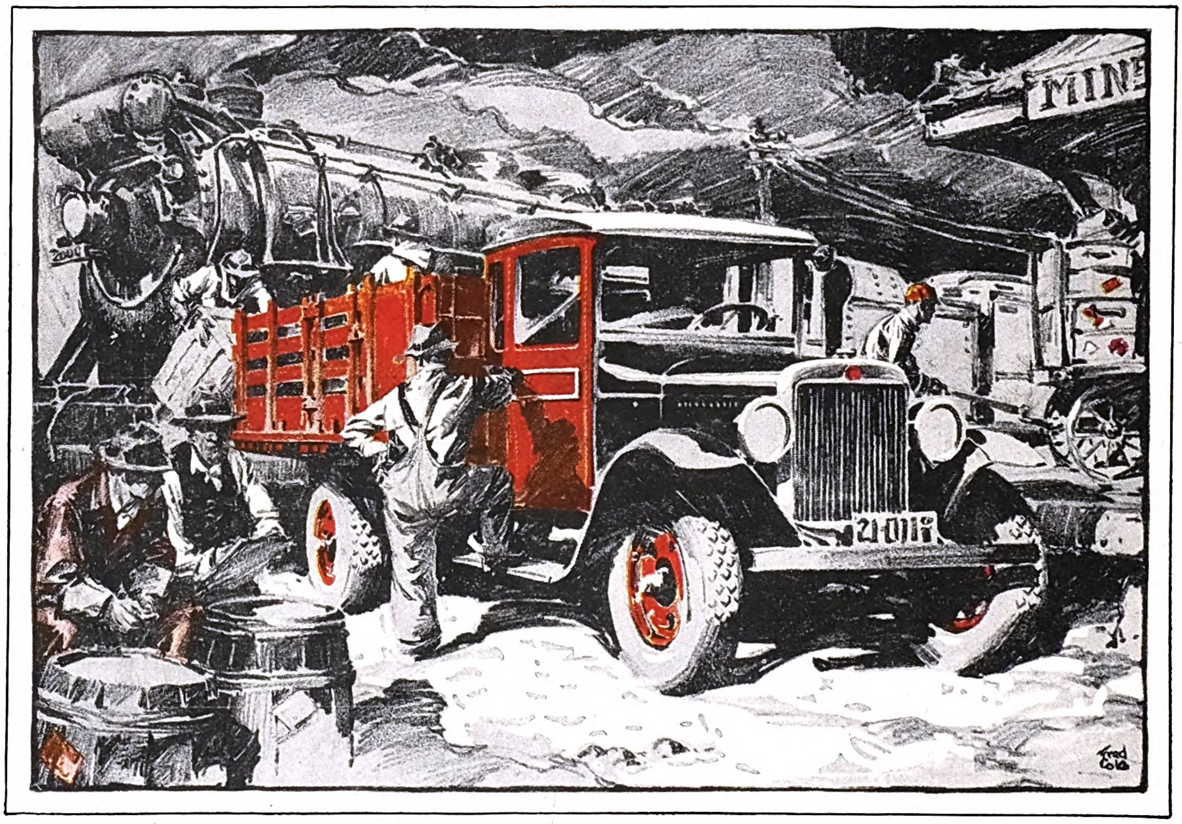
HOWARD V BROWN

SOLAR RESEARCH FOR AMATEURS

THE ULTRA-VIOLET QUESTION

FOOD FROM WOOD PULP

DODGE BROTHERS TRUCKS



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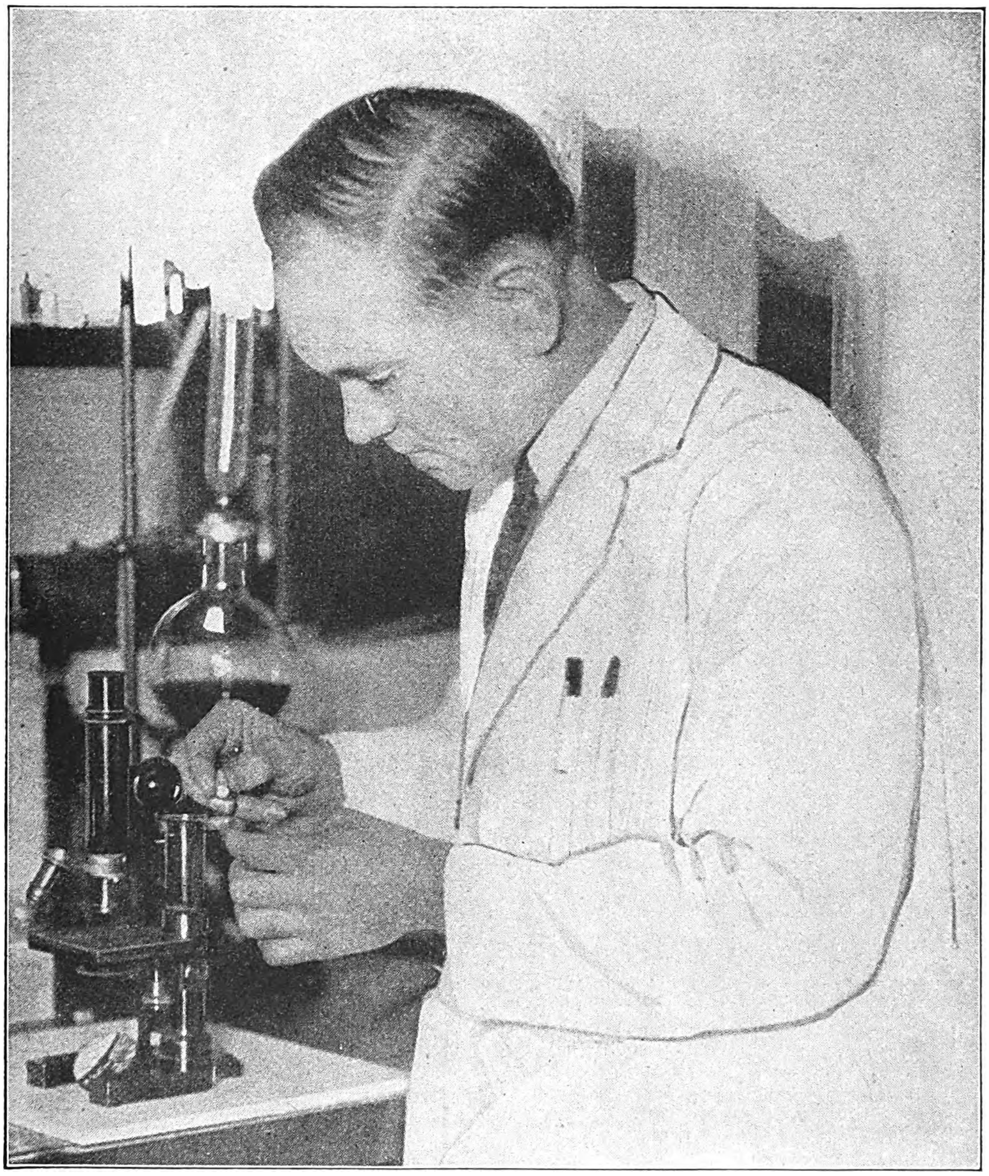
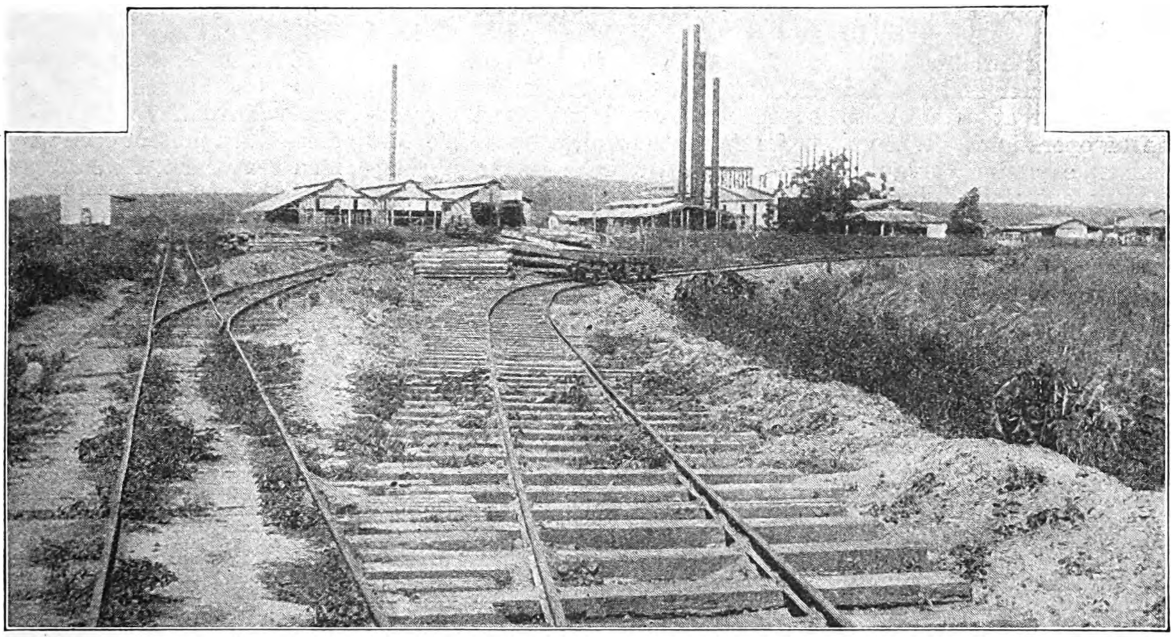


Doctor Oliver Kamm

THIS year the annual One Thousand Dollar Prize of the American Association for the Advancement of Science was awarded to Dr. Oliver Kamm, Research Director of Parke, Davis and Company, honoring his discoveries on hormones extracted from the pituitary gland. What Dr. Kamm has accomplished after much painstaking research is the isolation of two secretions called hormones (so-called "chemical messengers of the body") found in the back lobe of this tiny gland which is situated at the base of the brain. The front lobe of the pituitary gland, it will be recalled, regulates the growth and shaping of the body; dwarfs and giants owe their abnormality to its malfunction. The back lobe, Doctor Kamm has shown, produces the "alpha" hormone which is of value in obstetrical practice; also the "beta" hormone which regulates the amount of water in the tissues of the body. Some individuals are highly sensitive to this hormone; these people are usually fleshy. Others who are not so sensitive to it or whose supply is deficient are likely to be thin in spite of all the "stuffing" they may do in an attempt to put on weight. Dr. Kamm points out that the latter work is entirely in the experimental stage and warns that premature hopes should not be aroused. The significance of the discovery is that new physiological researches into hormone action have been stimulated and the entering wedge has been provided for a chemical study of the pituitary gland. What may result is unknown.



BANDITS WHO LAID THESE RAILS HAD NEVER SEEN A LOCOMOTIVE

This railway may not be quite as good as the one the Broadway Limited flies over, but when the desperados had finished building it through the trackless wastes of Paraguay it served the purposes of peaceful industry

A Factory in the Wilderness

With Bandits and Savages for Workmen, a Huge Quebracho Extract Plant Was Built in the Heart of the Jungles of Paraguay

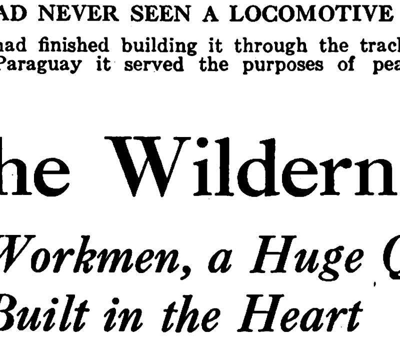
By WALTER S. HIATT

CONSIDER a few of the achievements in the career of George A. Kerr, leather chemist and master builder at home and abroad. He made savage Indians do the work of civilized man. He made the wilderness work for him. In nine months he built a dock, an iron and brass foundry and a huge carpenter shop, made seven million bricks, laid a railway line 60 miles long, rigged up 200 new ox carts, and then built a plant covering two acres, costing two and a half millions and turning out 70 to 80 tons daily of the quebracho liquid used to tan leathers.

KERR is of the new kind of frontiersmen whose work shows that the spirit of the old pioneers is not dead and that the world still has frontiers to be conquered. Then, too, he is one of those scientists who are doing so much for American industry. He has been working for 30 years in the leather industry, revolutionizing methods in tanning and dyeing, until he has come to be regarded as the only living expert in all branches of the industry. Step by step, year by year, he learned how to do things.

But let this man who brings things to pass tell his own story as he told it to me, in his own unaffected style.

Did you ever try to make wild Indians and bandits do the work of highly trained mechanics? asked Mr. Kerr. The job before me was to build a town, a railroad, and the world's largest tanning extract plant. To do this I had plenty of experience, unlimited money, promises of machinery to come, a flat piece of land on the upper Paraguay River, a small gasoline boat, two platoons of soldiers loaned by the Paraguay government, a meagre smattering of Spanish and no labor whatsoever.



GEORGE A. KERR

I was 350 miles from the nearest city. I was two months from my New York headquarters by cable, and three or four months by letter. I was 1600 miles from the Atlantic Ocean by river and much farther from the Pacific ports in a communication sense. There were not ten friendly white men in the surrounding area of 200,000 square miles of primeval jungle.

Because I am known not only as a research worker and consultant in leather chemistry but as a practical builder of model tanning plants, the International Products Company, once dominated by Perceval Farquhar, long identified with South American projects, sent for me and asked me to help in a plan that involved wresting the quebracho industry from Germany. With higher cost of production and the vanishing of the American chestnut, quebracho is the wood now most widely used for vegetable tanning. Previously, the quebracho logs had been floated down river to Atlantic ports, shipped to the United States and to Europe, and there ground up. The new plan was to use a forest concession costing two million dollars and to put up a plant at the wood source.

I estimated costs, ordered the necessary machinery, a good supply of tools, camp building materials, plenty of tinned foods, medicines, some small arms, and materials for a railroad, and set out. I took steamer and decided I could find my labor at points close to the scene of operations. When I came to Asuncion, capital of Paraguay, I was brilliantly entertained by the president and the leading business men and politicians. They congratulated me on my courage, but said gently, "Excuse us, Senor, it can't be done. Why not stay awhile among us, build your plant here, and enjoy life and safety? Believe us, we know our country, and none of us has ever gone where you propose to go." The English and Americans I met said, "It just can't be done. You are not back home where skilled hands are to be had. People here never work. The very thought tires them. Why should they? Nature gives them all they need to eat, they do not require many clothes, and the cooking, the washing, and the planting are done by the women."

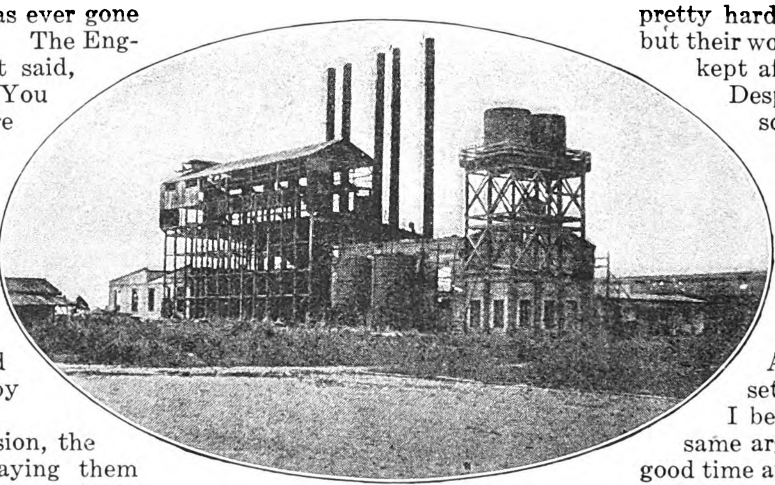
Finally I got a concession, the loan of some soldiers, paying them wages, of course, which they probably wouldn't otherwise get. They had a fine, faithful officer in command, and when I took the next boat up river we made quite an imposing party. All the officials and white men of the city gave us a grand send-off and wished us a quick and safe return. They were pretty sure I wouldn't be long.

As I went along I established a line of communications, and learned all the lore they had about fevers and Indians and the jungle. The higher up river I got the more discouraging were reports about workmen. Of course, I made friends with the river boat captain. He was one of my communications to the rear, and either he or one of his friends would have the hauling of the machinery and gear that was to be shipped.

Up river, a hundred miles or so, at the triangle formed by the junction of Bolivia, Brazil, and Paraguay, the captain told me, were two towns, Suarez and Martinho, pirate ports where foregathered all the bandits, outlaws, and escaped convicts of the three countries. He would bring me some of them, he promised, if I would pay their passage money and give him a bonus. He smiled darkly when I asked him how he would do it. I didn't press him. That was his affair. "They won't work and they are dangerous, and I advise against it, as a friend, but if you insist, they are yours," he said. I gave him an advance.

After he went on I set about preparing a camp for myself and the soldiers. As a safety measure we built a rude and temporary blockhouse of logs, mud, and palms in the middle of a clearing and close to the river bank, so that we could command any attacks from that direction. We also built a rough storehouse for my baggage and in that I lived for the time. We next put up a long rude shelter at a distance of 50 yards for the first workmen who would arrive.

Within a week my boat captain returned. When he drew alongside the bank I saw by the smile on his face he had been successful. He sent ashore about 50 of the roughest men I have ever set eyes on. And they had their women with them. That looked bad for it meant fights over them, yet I knew enough about human nature to believe those women would help me get work out of them.



IT STANDS ALONE

No other factory is within 1000 miles of this huge South American tanning extract plant

These ruffians swaggered ashore with their bundles, their arms, and their fighting cocks, and began a clamor for food and quarters. We made each man pass through the blockhouse, and there we took his name, his trade, if any, and his knives and pistols. When the last man had passed through we sent a lot to the shanty prepared for them.

They slunk away, growling, threatening, swearing horribly. My friend the river captain nudged my arm and whispered: "I explained that you were a rich and foolish American who actually expected people to work, that if they came here they would get plenty of food, and hinted there might be some loot, when they got tired of their holiday. And now you have spoiled their plans."

Now I had my working nucleus. But I realized those men would never do an honest day's work if they were not outwitted. So I went to them with a guard of soldiers and had it explained to them that they were to be well treated, well fed, and well paid. In return I wanted their friendship and aid. If I did not get that I would shoot or have shot any man who revolted. I then called together the women. I explained to them that if they made their men behave they would each get a new dress and a present each week. If their men beat them, I would punish them. If their men didn't work, there would be no food.

I set the men to work building a street lined on both sides with separate cabins—a home for each man and his wife. I detailed men or their women to keep the streets clean, and set up fines for throwing filth about. It came pretty hard to those fellows to work, but their women kept after them, and I kept after the women.

Despite the it-can't-be-done school, the ground work of my plan, labor, was laid. My captain brought me another lot of men, and every captain who stopped was offered the same terms. Pretty soon these vile ports up river were getting depopulated. As nobody could leave the settlement to carry word back, I believe each captain used the same argument—idle living, food a good time and, eventually, loot.

From now on nearly everything I did was done backwards. I had my town almost built before I had any productive work for my men to do. Indeed, I began to fear my machinery would not come in time to give them any real work and thereby save their souls and my big job. The first thing for such a job, of course, should have been the building of a landing stage. With insufficient tools, I had the men cut down some straight trees, trim them, saw them into 30-foot lengths and roll them to the bank. It wasn't easy. There seemed to be 18 feet of water at the bank, but underneath the river bed there was about 30 feet of soft mud. When I sank a pile it just kept on going. I had to splice two together to find bottom. However, one way and another we got a strong dock built.

Then it was up to me to find more work for the men, while I was waiting for the machinery and supplies. When I had decided to wait about another week or two and let them enjoy a holiday, the food supply gave out and there was trouble. So I knocked the tops off a dozen boxes of tea biscuits and served that as rations. I next hurriedly organized my commissary, sent some soldiers out to buy a few dozen head of cattle, arranged with the Indians for a steady delivery each week, built a slaughter house, and staved off famine and riot.

Meanwhile, I had been waiting for the fruition of my plans to build cement foundations for my two-acre factory. My own cement didn't come and I received word from Asuncion and other places that cement couldn't be had in quantity until next year. Next I lost time in trying to buy bricks. But no bricks were available, and, anyway, so the word came back by river steamer, no masons could be had to do the work.

I decided to make my own bricks. Good or bad, the work would keep the men busy. I conferred with river captains. They said nobody had ever made brick out of *chaco* clay. Therefore, it couldn't be done.

ANYWAY, great quantities of straw and manure were needed to mix with the clay, as was the custom of the country, and where would I get the necessary huge amounts of such material? I learned how to make bricks, however, 20 years earlier, out in Columbus, Ohio, on the banks of a river. As a trial I took some of the camp clay and mixed it, set it into forms and dried out the model pieces in a miniature kiln. The result was bricks.

I then set the men to work in gangs, some digging foundation pits, some making a carpenter shop, some a big kiln, some making barrels to bring up river water. Everything went at once. There was no beginning and no ending. The men did what I told them, rather patiently by now, and few made mistakes after they had learned what I wanted and how to do it. The very fact that they were unskilled was a help, as they had nothing to unlearn.

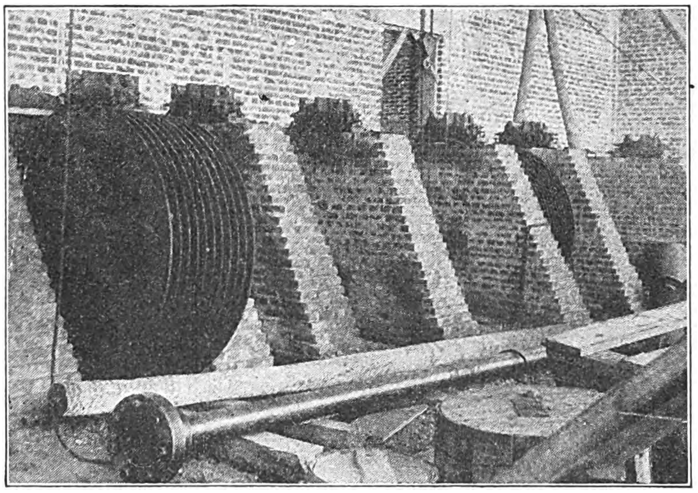
The machinery for my plant began coming along in driblets. When my 17-ton extract boilers arrived, sent up river on a lighter, I had only a 5-tone crane to lift them ashore. If the crane had broken under the triple weight, these boilers would have gone into the river.

It was just one chain of bad jobs after another. When I got up in the morning I did not know what new disaster awaited me. When, for example, I got the boilers safe ashore, I found all the brass parts had been stolen. So I had to build a brass and iron foundry to make new parts. Most of my machinery arrived incomplete. The steel frames for my plant had been taken from airplane hangars in the United States and, of course, were makeshifts. During the voyage the ship had caught fire and the heat had twisted the frames out of shape. I had to make the peon blacksmiths straighten them.

The iron waterpipes for the plant were stolen in shipment. I had to make and use wooden ones. I had to do all the thinking and about one twentieth of the physical work for a settlement that now consisted by the third month of nearly a thousand people.

One day a soldier reported that an American cowboy was in a canoe at the landing and wanted to come ashore. As I had given strict orders that no one should enter or leave camp except on permission, I was asked what should be done. I went to the landing and looked the man over. He was tall, lanky, brown from sun and weather, physically in good trim, and with a pleasant grin on his face. "My name is Ike," he called, "and I was wondering about stopping here, sort a-lookin' for a job." I didn't ask him, even by way of form, where he was going, where he came from, his last name or why he was there. That would have been bad form indeed. Rightly, I concluded he was a fugitive from justice.

"COME ashore, and have something to eat," I suggested, as his looks pleased me. Here at least was a man who could talk my language and understand what I was doing. If he measured up, he was more precious than fine gold. But I couldn't let him suspect this. We talked for a time. He showed no surprise at the gigantic job I had undertaken, offered no advice. He knew the country. We struck an agreement, and he showed such quick intelligence, reliability and sturdiness that he became my assistant chief engineer, although he knew not one thing about engineering in the expert sense.



"IT COULDN'T BE DONE"

So said the natives, but Kerr succeeded in making millions of bricks of *chaco* clay which water wouldn't wash back into mud

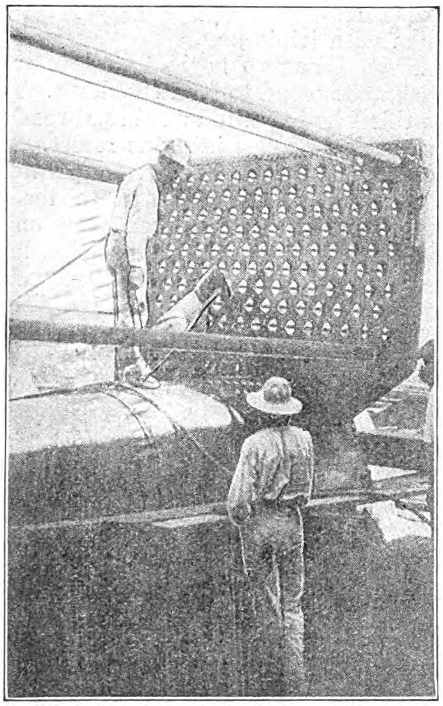
Slowly the building, which as completed stood 75 feet high, with standpipes and chimney stacks 125 feet high, rose in the clearing. When all the machinery was in place I put on the roof. For this, as I had no girders of steel, I had to make my own supports of wood. To get the men to raise those standpipes high in the air was a hard job, and I had to bribe them with triple pay.

Next, I had to begin to get in my quebracho wood to feed the plant. To do this I had to build a railroad reaching back 60 miles into the forest. I had never built a railroad, nor operated a locomotive. Yet, I had to teach men who had never even seen one, get them to build grades, cut ties, lay and bolt rails in place, spike them, and operate the locomotives. Had they known what dangers I led them into, by boiler explosions, either at the plant or on the rails, they would surely have deserted.

ONE way or another, at the end of nine months the plant was turning out 60 to 70 tons of quebracho extract daily. It was at this period that all my work was threatened. With the slackening of the hard work and suspense of getting the plant to operate, the men grew restive. There was an attempt to murder me as part of the old plan of the pirate towns for loot. While I always went armed, always closed my house tightly at night, and watched my food against poison, I could never be entirely safe against men whose work required them to carry machetes, the universal hand tool of these countries. The danger came upon me because I had extended operations far outside of Puerto Penasco, the name I had given the settlement.

As the first practical scientist and white man to explore that country for its commercial possibilities, I had to roam on horseback over great distances, accompanied, of course, by a personal bodyguard. On such occasions the camp was left in charge of my soldier captain, upon whom devolved the task of keeping order. On one of my journeys to replenish the herd of 25,000 cattle which I maintained as a stock to draw upon to feed the workmen, I was followed by a group of savage Indians who signified, by dropping arrows in front of me, that I must not penetrate the pampas farther. Hiding in the tall grass they used this customary warning to make me turn back. My horse fell into a bog and threw me. In the dusk I saw signs of many jaguars, pumas, and *gato de monte*, ready to fall upon my party and myself. We set a watch for the night and with the dawn turned back.

When I reached Puerto Penasco I scented trouble. The work was going along haltingly. The night before some of the men had broken into the whiskey and wine rations. That night I closely barricaded my own quarters. Early in the night I was awakened by



ONE OF THE BOILERS

The boilers were shipped to Puerto Penasco knocked down, and were assembled in position

a scuffling, and through a porthole saw a mass of men slowly closing in on my quarters. I threw open the door and made for the group, shouting to the soldiers not to fire.

I demanded to speak to the leader. One of the men began a speech. I asked him if he had any complaint. Did I not do more work than anybody? I asked. Did I not provide food, pay well, treat the men well? These words of mine pleased the other men. Then I seized the man, took away his machete, and marched him to the soldiers' quarters with orders to lock him up.

The next day work was resumed, but I knew the incident was not finished. I doubled the guard about the motor launch. To keep it in my control was vital as a means of sending word down river in case of any real outbreak. Soon, I got a clue to the whole matter and found there was a plot afoot. An Englishman rancher had befriended and cared for a native woman and her family. They told him that the pirate towns up-river were planning a descent on my settlement, this rancher, and even some of the down-river villages and the big town of Concepcion. They had secured a small steamer for their raid. He sent this information by letter and told me he was fleeing.

I DISPATCHED my motor launch to warn Concepcion and to ask for more soldiers. Meanwhile, I put my soldier captain on his guard, as well as all the foremen I could trust. I knew, however, that in a real attack I should be helpless, with 50 soldiers against several hundred armed and desperate men, bent on loot and able to fire from a steamer, perhaps armed with cannon or machine guns. Nevertheless, I was determined not to lose the fruits of my nine months' work and have my plant and my organization destroyed.

I could take no chances with arming any of the workmen, as they would be too ready to turn against me and rob the stores. I had taken this risk since the beginning. My mind was therefore prepared for the attack, which I realized must come sooner or later. By the curious grapevine intelligence of the natives, there was not a soul among the workmen who did not know of the planned attack. I knew this by their attitude—unusually complacent and obedient, biding their time to make a break for what they considered freedom.

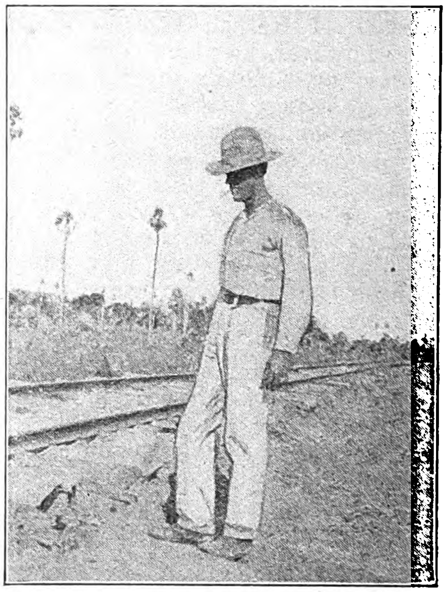
BY great good luck, after two nights of waiting, a small steamer came from down-river in answer to my call for help. There was a handful of soldiers on board. Hardly had it stopped before my plan was ready. I determined instead of waiting the attack, to attack myself. I got aboard with a dozen of my soldiers, plenty of rifles and ammunition, and bribed the captain to take me to Suarez and Martinho.

We crept in to these ports by night and found the pirates had not yet started on their expedition. We went alongside the steamer they were planning to use, quietly knocked on the head the men in charge, bound them, and so disabled the machinery of the engine room that the steamer was out of commission for many weeks. I knew that by that time the pirates might abandon their plan, realizing that I would bring up a larger body of soldiers to Puerto Penasco.

I returned to Puerto Penasco and quietly let it get whispered about that another force of soldiers was arriving, although I knew I would not get them because of the slow ways of the country, and, indeed, I didn't want them about. There were, in fact, no more attacks planned on me so far as I knew during the rest of my stay in Puerto Penasco.

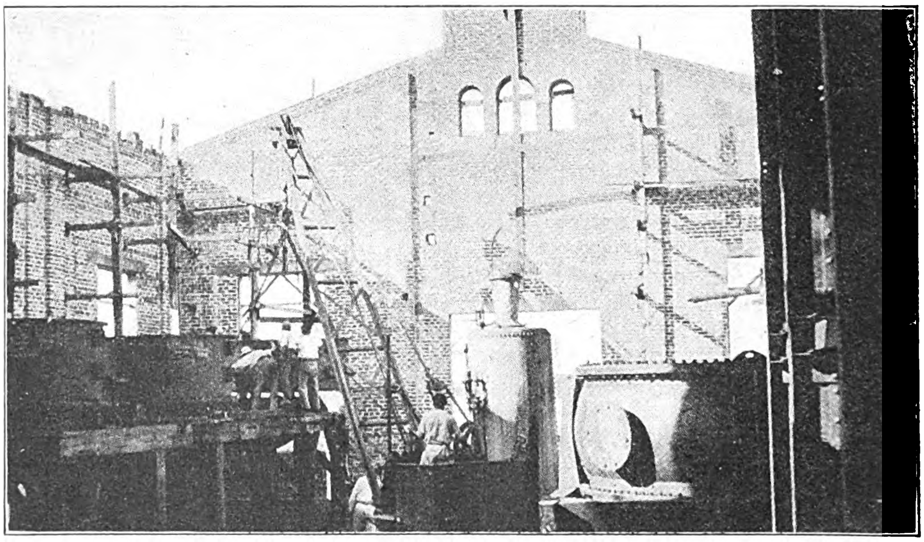
After this display of force, things at the extract plant went along with comparative smoothness, and the output assumed the steady flow of a well-organized plant.

When I was relieved, with my job done and the plant in good order and ready to turn over to an operating manager, I came away with regret, but enriched by the knowledge that men may do the seeming impossible if they will try hard enough and by the realization that some of the world's greatest adventures can be had from plain, useful work.



"IKE"

This American cowboy, probably a fugitive from justice, was of great assistance to Kerr



EVERYTHING DONE TOPSY-TURVY

To keep all hands too busy for trouble, each job had to be done when it could; the machinery for extracting the tanning liquor was being installed in the factory before the roof was put on

Courtesy Moth Aircraft Corporation

Our Light-Plane Contest

Complete Details of the Scientific American 500 Dollar Prize for a Light Airplane Design

ONE of the most promising aspects of American aviation is the increasing interest of the public in the light plane for private ownership. In England there are now over 30 flying clubs, employing light two seater planes exclusively. Members of these flying clubs think nothing of extensive trips over the whole of Europe. Flights in light planes have been made from London to Cape Town, and from London to Australia.

With the rapid increase in the number of airports and landing fields in the United States, and the vast distances in this country uninterrupted by customs or geographic barriers, the large number of flying schools now in operation, and the enthusiastic interest of young America in all things pertaining to aviation, there is not the slightest doubt that private and sports flying will assume large proportions.

The primary requirement for private flying is a suitable light plane design.

As we announced last month, thanks to the generosity of Colonel R. Potter Campbell, President of American Cirrus Engines, Inc., the SCIENTIFIC AMERICAN now offers a prize of five hundred dollars for the best design of a two seater plane submitted under the following rules of competition:

1. The design is to be for a two-seater light plane around the Cirrus Mark III engine, specifications of which are:

Type	Four-cylinder-in-line, vertical
Number of cylinders	Four
Cooling	Air
Normal b. hp.	88 at 1900 r. p. m.
Maximum b. hp.	95 at 2100 r.p.m.
Weight dry	280 lb.
Direction of rotation	Clockwise
Ignition	Two magnetos
Length overall	46.5 in.
Height overall	37 in.
Width overall	17 in.
Bearer centers	Front 15-½ in. Rear 19 in.

Cowling and installation diagrams of this type of engine will be furnished by the Committee upon request.

2. The design is to be one for a plane which will be most suitable either as a training plane or as a sport plane for private ownership.

3. Minimum equipment allowed by the Department of Commerce in the way of instruments will be required.

4. The fuel supply shall provide for five hours at full throttle.

5. Provision for 50 lbs. of baggage and a baggage compartment.

6. Minimum gliding speed of 40 miles per hour. Maximum speed to exceed 95 miles per hour.

7. No restrictions are to be placed on the type of design. The fuselage shall be of metal construction, but the wings may be of wood construction.

8. Each competitor for the prize will be required to submit the following information:

   a. Three views of plane and main dimensions and characteristics.
   b. Detailed weight estimate.
   c. Balance diagram and stability and control considerations.
   d. Preliminary performance calculations.
   e. Preliminary stress analysis.
   f. Drawing showing power-plant installation with gasoline and oil system.
   g. Drawing showing accommodations for pilot and passenger.
   h. Sketches or preferably drawings illustrating the structure of the plane, wings, fuselage, tail surfaces, landing gear, and controls.

9. Drawings and data (preferably in typewritten form) should be in the hands of the judges on or before August 15th, 1929.

10. The following system of rating will be adopted:

General suitability of the plane for training and private ownership purposes and general excellency of the design	20 points
Performance	15 points
Power plant installation	15 points
Construction and ease of maintenance	80 points

All drawings and data will have to be submitted in triplicate.

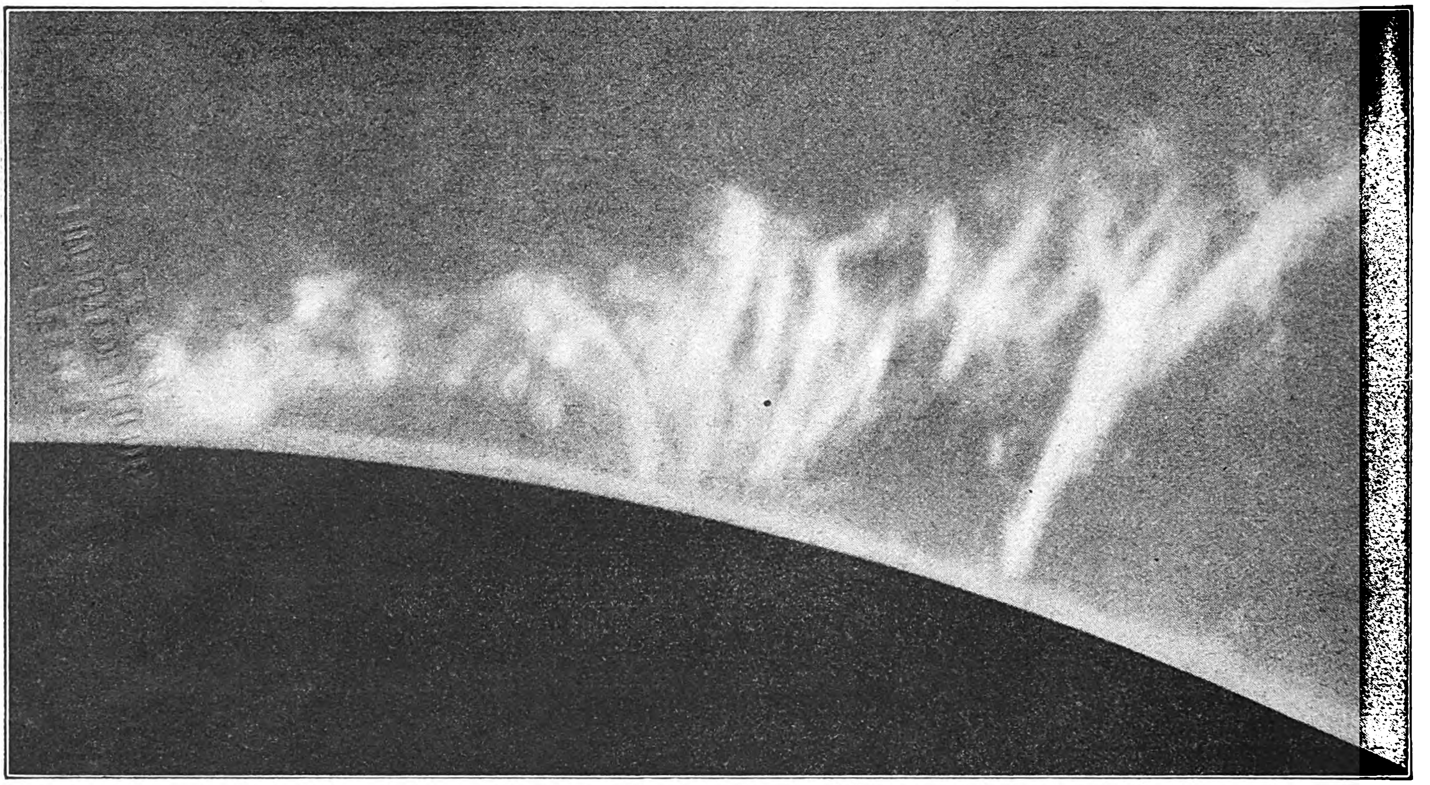
In addition to the cash prize, the judges may award one, two, or three honorable mentions.

All drawings and designs will remain the property of the designer, but the designs of competitors receiving the prize or honorable mention may be published in the SCIENTIFIC AMERICAN.

The judges have been selected so as to cover varying phases of the problem and include:

Miss Amelia Earhart,
Mr. George Palmer Putnam, of G. P. Putnam's Sons, private plane owner,
Professor Alexander Klemin, of the Daniel Guggenheim School of Aeronautics, New York University.

All communications regarding this competition should be addressed to the Committee, Light Plane Design Competition, Scientific American, 24 West 40th Street, New York City.



SOLAR PROMINENCES. THE MAXIMUM HEIGHT SHOWN IS 80,000 MILES

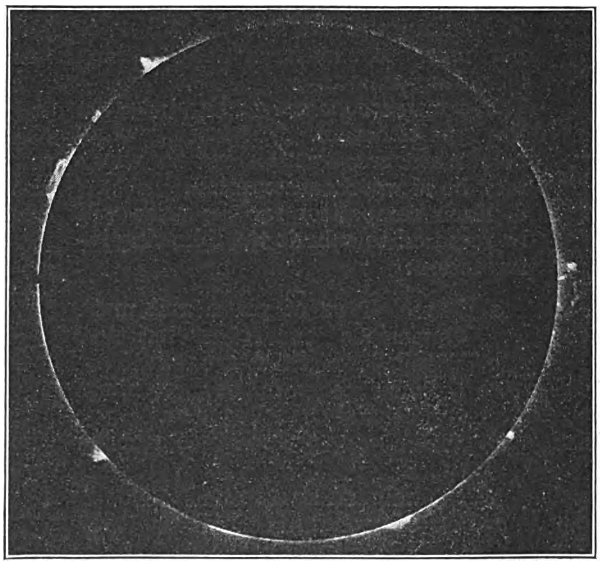
Solar Research for Amateurs—I

By Means of the Newly Developed Spectroheliosope, Vivid Phenomena on the Sun May Now Be Observed in Motion by the Amateur Scientist

By GEORGE ELLERY HALE, Sc.D.
Honorary Director, Mount Wilson Observatory of the Carnegie Institution

NO chapters in the history of science are more inspiring than those that recount the discoveries of the amateur. Hampered, it may be, by lack of equipment, situated where conditions for research are not of the best, and often compelled to devote his best hours to other pursuits, the amateur, rising above all discouragement, has continued to pour a flood of new ideas and significant observations into the ever-widening sea of scientific knowledge. Many a great name is associated with a modest beginning, and many a discovery has been made with inexpensive apparatus. Intense interest and persistent purpose naturally bring their own reward.

The amateur thus has a great advantage over the perfunctory toiler, driven into research by someone who thought it might prove interesting, or lured on by a desire for fame or fortune. His eye is not fixed on patents or prizes, decorations or degrees. He works because he cannot help it, impelled by a genuine love for his subject and inspired by an irresistible influence, which he seeks neither to justify nor to explain. His reward lies in the work itself and in the hope that it may contribute something to the advancement of knowledge. If there is any means of deriving greater satisfaction from personal effort one must go a long way to find it.



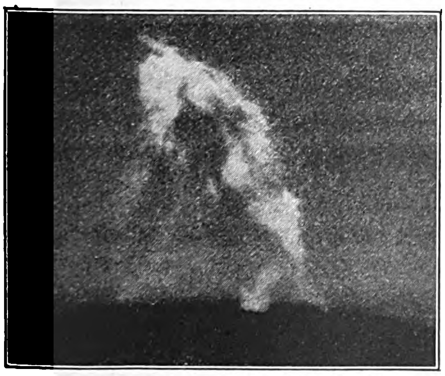
SOLAR PROMINENCES

Photographed in full sunlight with the spectro-heliograph. Taken on Mount Wilson with the red hydrogen line ($H\alpha$), September 21, 1909. (The image of the Sun's disk was covered with a circular metallic screen)

It naturally follows that the world owes an immense debt to the amateur. His compelling interest, never flagging through the years, often leads to important advances. Thus, Schwabe, the apothecary of Dessau, recording sun-spots day after day for 43 years with his small but "imperturbable telescope," discovered that their number waxes and wanes in the now familiar sun-spot period. Burnham, busy all day as a Chicago court stenographer, discovered nearly 500 new double stars with a six-inch telescope in his back yard. Huggins, in spite of the smoke and fog of London, borrowed instruments from the Royal Society and laid the foundations of astrophysics. Herschel, the organist of Bath; Barnard, the Nashville photographer; Lockyer, the War Office clerk; Bond, the watchmaker of Maine; Schumann, the Leipzig machinist; and many others, limited in time or means, have also left their names in the permanent roll of scientific discoverers. Darwin, Faraday, and Rayleigh, though they gave their whole lives to research, were essentially amateurs, members of a guild devoted supremely to science and never to be confused with the idling dilettantes of the popular imagination.

While it is still possible in many fields to contribute to knowledge with the aid of small instruments of standard design, the wise amateur quickly takes advantage of favorable opportunities to enter untrodden territory. Thus while routine observations of variable stars visible with a small telescope are very valuable, the amateur who attaches a thermocouple or photoelectric cell to his equatorial can detect and measure much smaller light-variations than the eye can see, and thus discover new and important phenomena. The work of Stebbins is a fine illustration of this. A similar opportunity for entirely new work, due to the recent development of the spectroheliоscope, now exists in the field of solar research.

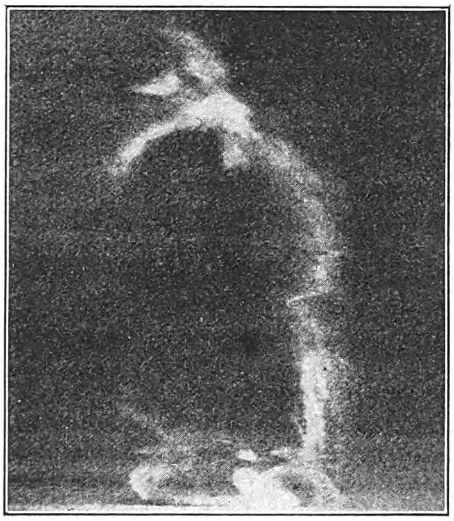
FROM whatever angle you look at it, the Sun offers interesting and remarkable subjects for investigation. Unlike most celestial objects, the brilliant and spectacular phenomena of its atmosphere are never twice alike, and the most violent outbursts of terrestrial volcanoes are tame affairs in comparison with solar explosions. In order to gain any conception of the fantastic beauty of solar prominences it is necessary to see them in action. As Secchi has said in his book on the Sun, it is impossible to reproduce "the vivacity of color of these enormous masses, or to depict their rapid motions when they are shot by eruptions from the interior above the surface of the Sun. The best drawings are inert and lifeless when compared with the actual phenomena. These incandescent masses are vivified by internal forces which seem to endow them with life; they glow with intense brilliancy and their colors are so characteristic that they enable us to determine spectroscopically the chemical nature of their constituent gases."



AN ERUPTIVE PROMINENCE

Photographed with the Kenwood spectroheliograph, Chicago, March 25, 1895, 10h 40m A.M. Height of prominence, 162,000 miles. Compare with photograph above

Such brilliant phenomena are striking enough in themselves, but their relationship to terrestrial disturbances makes them doubly important. If you are interested in radio, or the aurora, or terrestrial magnetism, you will want to learn the source of the electrified particles which are shot from the Sun into the Earth's atmosphere, where they arouse the Northern Lights, initiate magnetic storms, affect radio transmission, produce powerful earth currents in telegraph lines, and sometimes puncture Atlantic cables. They are popularly supposed to come from sunspots, but some of the largest spots produce no such effects and attention should be directed to the occasional eruptions, occurring on the disk near certain types of sun-spots, which the spectroheliоscope now renders visible.

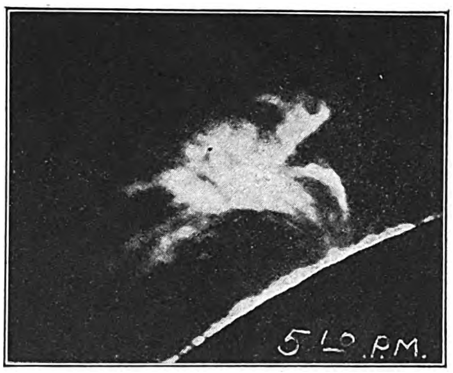


110 MILES PER SECOND

The prominence shown at left below, photographed at 10h 58m. Height, 281,000 miles

If the nature and evolution of the stars appeal to you especially, remember that the Sun is the only star near enough the Earth to be studied in detail. To see the other stars as we do the Sun, to discern their huge disks, the spots on their surface, the flames in their atmosphere, it would be necessary to approach them closely, and there is no prospect that any telescope, however powerful, will ever make this possible. The larger and more perfect the instrument and the better the atmospheric conditions, the smaller their needlepoint images appear.

How fortunate, then, that one star is so near at hand! This neighboring object, our own Sun, is proved in a score of ways to be a perfectly typical star, similar in chemical composition, in size and in structure to millions of other stars in the remote distances of space. It is so near us that any telescope will show its disk and the spots that come and go on its surface. These and its other phenomena are most varied in character, constantly changing in number and in form, and suggesting problems of every kind for solution. Moreover, with the aid of a spectroheliоscope, the amateur will be able to observe, not merely the spectacular outbursts of the chromosphere and prominences encircling the Sun's circumference, but also the little explored region of the solar atmosphere now visible in projection against the disk. Here is a new field, open to amateurs, for discoveries of prime importance, which will aid in solving many puzzling problems of solar and stellar physics.

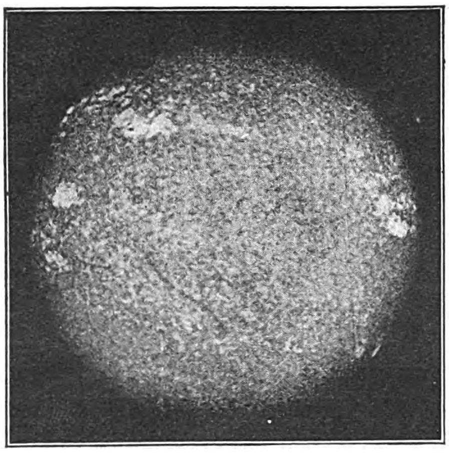


A QUIESCENT PROMINENCE

A slowly changing or "quiescent" prominence, 110,000 miles high. Photographed at Mount Wilson with the $H\alpha$ line, 1927

The Sun may also be regarded in still another aspect, the importance of which has recently been greatly enhanced by the revolutionary progress of physics and chemistry and the rise of the Einstein theory of relativity. In an article on "The Sun as a Research Laboratory" (*Journal of the Franklin Institute*, July, 1927) I have recently pointed out some of the fundamental advances in physics which are the direct result of solar discoveries.

AS a matter of fact, the Sun is an immense furnace, with a surface temperature of about 6000 degrees, Centigrade, and an internal temperature reaching millions of degrees, sufficient to strip the atoms wholly or partially of their electrons. Between this inner region and the visible surface of the photosphere the chemical elements recover most of their electrons, and we can observe their luminous vapors at various levels in the solar atmosphere under a wide range of conditions, which throw much light on the nature of matter. Thus the establishment of the fundamental principles of spectrum analysis, the discovery of the important element helium, and the first clue (through Lockyer's detection of the "enhanced" lines) to the modern theory of the constitution of matter, are all results of solar research. For other illustrations I must refer the reader to my Franklin Institute paper.

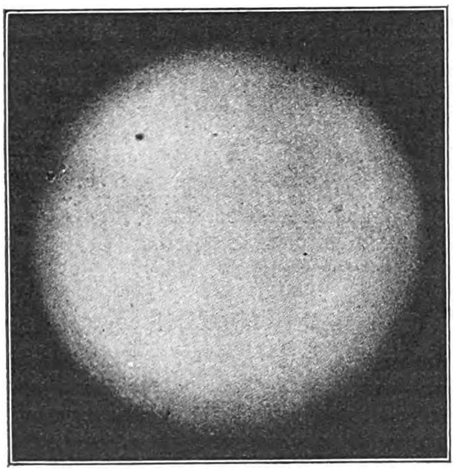


THE CALCIUM FLOCCULI

Photographed with the calcium line K, September 27, 1926. Compare this with the illustration below. Note same sun-spots.

All of the solar phenomena I have mentioned are easily within the reach of the amateur. If lucky enough to have access to a small machine shop, he can build his own instruments and most of the optical parts. If not, he may purchase his entire equipment at moderate cost or buy only the optical parts and employ a local machinist to do any of the machine work that is beyond his own capacity.

The classic discovery of Janssen and Lockyer in 1868, which made possible daily observation, in full sunlight, of the prominences previously visible only during total eclipses, aroused widespread interest in solar research.



DIRECT PHOTOGRAPH OF SUN

Taken in mixed light of all available lines, September 27, 1926, at Mount Wilson

Fascinated by this advance, and dimly conscious of the boundless other possibilities of the spectroscope, I began solar work as a boy in 1883.

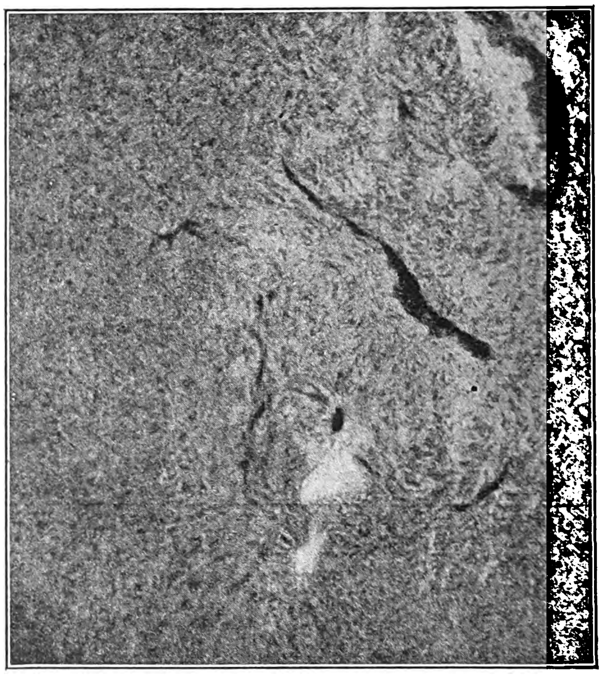
Six years later it occurred to me (as it had occurred to others) that by building up an image of the prominences upon a sensitive plate with the light of hydrogen or of calcium, I might photograph them without an eclipse. This I succeeded later in doing with a spectroscope, provided with a second slit instead of an eyepiece, through which a hydrogen or calcium line passed to the plate. When the slit of the spectroscope was moved slowly across the Sun, a complete image of all the prominences was built up on the plate by countless adjoining images of the narrow second slit. The bright light of the disk was excluded by a circular metal screen, and the encircling prominences were shown as distinctly as in photographs of total solar eclipses.

The next logical move (in 1892) was to try the same scheme for photographing the disk, where the calcium lines (H and K in the extreme violet) were known to be bright in many places. The spectroheliograph, as I had named the instrument, at once disclosed large bright clouds of calcium vapor (flocculi) in the solar atmosphere, which have since been extensively investigated by Evershed, Deslandres, St. John, and others. These bright flocculi lie at a low level, and do not project above the Sun's edge (limb) as prominences. Later, at the Yerkes Observatory, we found it possible to photograph the prominences projected against the disk as dark flocculi. They are generally dark because the hydrogen or calcium gas is comparatively cool at high levels, and thus absorbs the light from the hotter region below. The same plates also show the bright (hotter) gases at lower levels.

IN 1908 the Sun's disk was first photographed at Mount Wilson with the red hydrogen line H*a*, and great vortices or cyclonic storms were discovered in the upper hydrogen atmosphere. These were found to center over sun-spots, and soon led to the detection with the spectroscope of strong magnetic fields in all spots.

This brief reference to the photographic registration of the chief phenomena of the solar atmosphere is necessary to a comprehension of the new work of the spectrohelioscope. The reader who is interested in the details should consult the original papers and also the many publications of Deslandres, Evershed, St. John, and others, who have made many discoveries and important contributions in this field of research. Most of these papers may be found in the journals *Astronomy and Astrophysics*, *Astrophysical Journal*, *Comptes Rendus* of the Paris Academy of Sciences, *Monthly Notices* of the Royal Astronomical Society, and in the publications of the Meudon, Kodaikanal, Yerkes, and Mount Wilson Observatories, available in the large libraries.

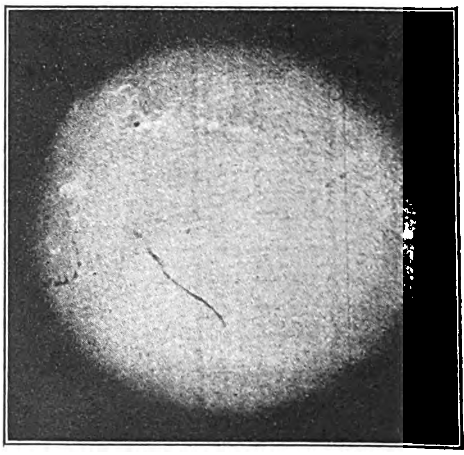
Our daily series of photographs of the solar atmosphere, begun at the Kenwood Observatory in 1891 and continued later at the Yerkes and Mount Wilson Observatories, contain many thousands of plates of the prominences and flocculi. Familiarity with these results has served to enhance my enthusiasm for the new possibilities recently opened by the spectrohelioscope.



BRIGHT AND DARK HYDROGEN FLOCCULI

These were photographed with the red hydrogen line H*a*, September 9, 1915, at Mount Wilson Observatory

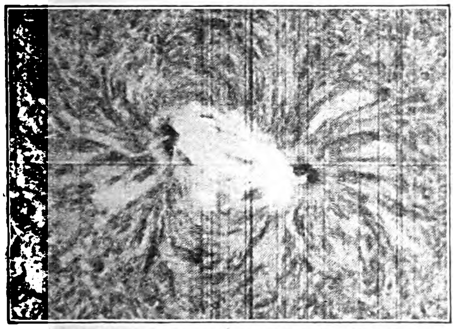
The spectroheliograph, as already stated, builds up its monochromatic image gradually, slit-width by slit-width, as the slit moves slowly across the Sun. The photographic plate, as it were, thus "sees" at any instant only a narrow strip across the solar image two or three thousandths of an inch wide, which it faithfully records, in its varied intensity, as an element in a composite image. A different mechani-



THE HYDROGEN FLOCCULI

Photographed with red hydrogen line H*a*, September 27, 1926. Compare with nearly simultaneous photographs, "Direct Photograph of Sun," and "The Calcium Flocculi" cal arrangement permits the same idea to be employed in revealing a large area of the hydrogen atmosphere directly to the eye. It is only necessary to utilize the well-known principle of the persistence of vision.

The first slit of the spectroscope, on which the Sun's image is formed, and the second slit, on which the red hydrogen line falls, are so connected that when the first slit moves, the second slit also moves in such a direction and at such a rate as to remain exactly upon the displaced hydrogen line. Then, if the slits are rapidly oscillated to and fro across a portion of the solar image, this region will be seen in hydrogen light through an eyepiece focused on the second slit.



COMPLEX HYDROGEN WHIRLS

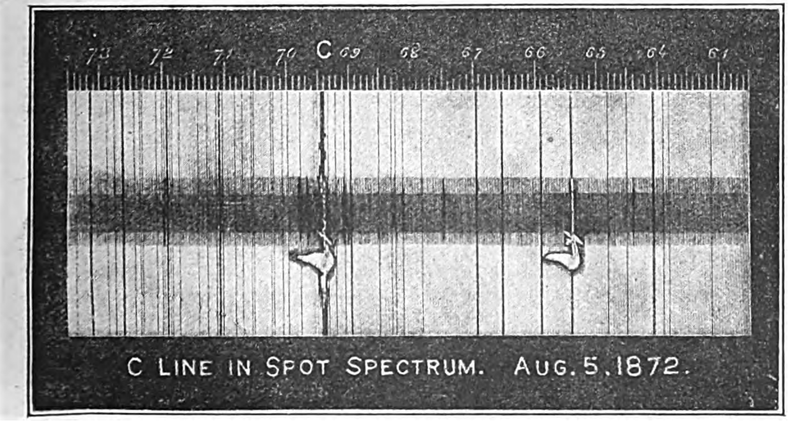
These were associated with a large bipolar sunspot, August 29, 1924. (Mount Wilson)

It is astonishing how this simple method, which was tried (but discarded) by Young in 1870 for observing the prominences at the limb, seems suddenly to bring to life the flocculi on the disk, which appear fixed and inert on photographic plates. There are several reasons for this. As the photographer using a spectroheliograph cannot see what is happening, he makes his exposures in a routine way and thus almost invariably fails to catch the successive phases of remarkable short-lived phenomena that often afford marvelous spectacles to the visual observer, who can pick out at a glance the most interesting and most active regions. Thus I have repeatedly seen with the spectrohelioscope the swift flow toward sunspots of masses of hydrogen larger than the Earth, adequately recorded only once with the spectroheliograph in a period of twenty years.

But the spectrohelioscope has another more important advantage, which permits the observer instantly to interpret phenomena missed altogether by the spectroheliograph, or so incompletely recorded that their interpretation remains obscure. This is due to the use of the "line-shifter," an adjustable plate of plane-parallel glass behind the oscillating second-slit, which permits the observer to set any part of the red hydrogen line or its wings on the slit during observation. In this way he can observe the form of the flocculus given by any part of the line, which is greatly distorted to the violet or red if the hydrogen is moving with high velocity toward or away from the Earth.

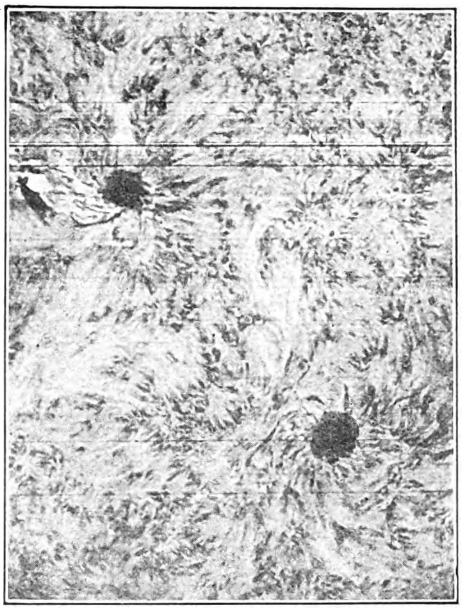
Lockyer and Young long ago saw and described the strange "motion forms" thus produced (shown in the illustration below). The bulge of the C (now called $H\alpha$) line toward the violet observed by Young on August 5, 1872, meant that the hydrogen gas at a point near an active sun-spot was approaching the Earth at a velocity of about 120 miles per second. Thus if a series of photographs of the $H\alpha$ line is made, with the spectrograph slit stationary at many successive sections across such an eruption, the measured displacements of the line will give the radial velocity at the corresponding positions of the slit. This is the principle of Deslandres's "velocity spectrograph."

THE spectrohelioscope is far quicker in action and its results are instantly interpreted. Imagine an arch of hydrogen, representing the trajectory of masses of gas continually shooting along the same path near the middle of the Sun. Like a projectile, the gas moves rapidly upward, curves over and travels nearly parallel to the surface, and then falls, curving back toward the surface. Thus in the spectroscope the $H\alpha$ line would appear twisted toward the violet at the point of eruption, less and less displaced nearing the center of the arch (where the velocity in the direction of the Earth becomes zero), and increasingly displaced toward the red as the descending branch of the arch is approached. As the projection of such an arch against the surface usually appears curved, and as its form cannot be seen at all without a spectrohelioscope, the task of photographing the $H\alpha$ line at several points along the arch, measuring its distortions at all these points on the photographs and interpreting the results would naturally take considerable time. Meanwhile the phenomenon may have passed through several stages and perhaps ceased altogether.



RED HYDROGEN (C OR $H\alpha$) IN SUN-SPOT SPECTRUM

As observed by Young in 1872. The distortion is due to motion of the hydrogen in the line of sight of 120 miles per second. (From Young, "The Sun")

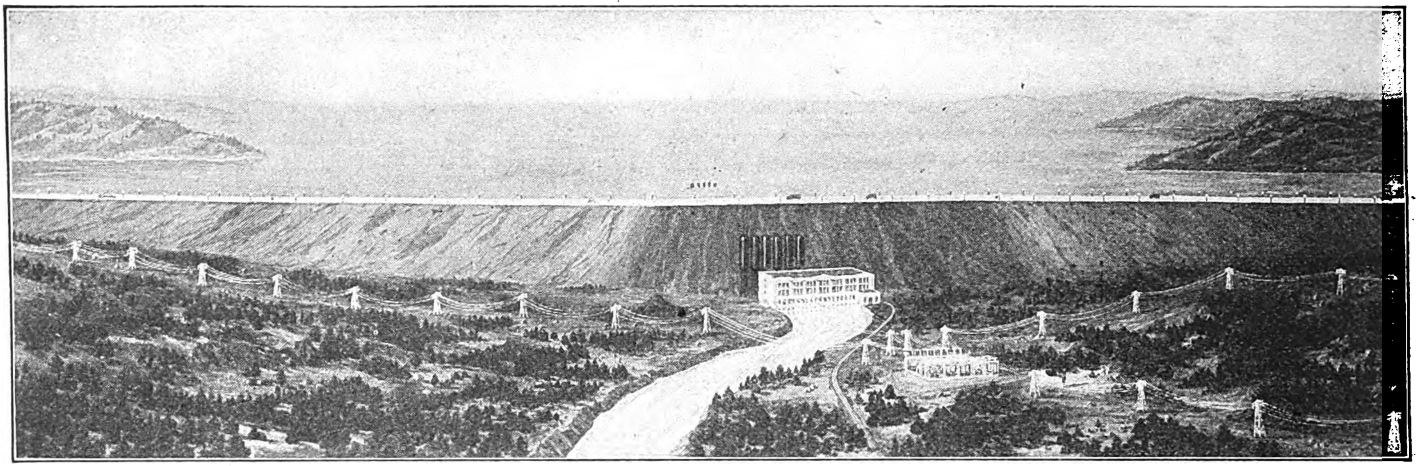


WHIRLS AND SUN-SPOTS

Counter-clockwise (N) and clockwise (S) hydrogen whirls associated with sun-spots in the northern and southern hemispheres of the Sun, September 9, 1908. Photograph made at Mount Wilson Observatory

With the spectrohelioscope the whole analysis can often be completed in a few seconds. As the $H\alpha$ line is moved across the oscillating slit, the darkest spot (maximum of intensity) of the arch is seen to move from its origin at the point of eruption (violet side of $H\alpha$) toward the center of the arch (center of $H\alpha$) and thence to the point of fall (red side of $H\alpha$). By reading the divided circle of the line-shifter at these points the corresponding radial velocities are obtained at once. Perhaps the most beautiful application of this method is in the measurement of the flow of hydrogen into the vortices centering in sun-spots.

IN the next issue Dr. Hale will describe the spectrohelioscope which the handy amateur astronomer may construct for a reasonable sum, using available blueprints, the cost being comparable with that of a fine radio set. Instructions for making the coelostat, eyepiece, and mirrors are contained in the book, "Amateur Telescope Making." A diffraction grating will be needed.—The Editor.



A MAN-MADE MOUNTAIN THAT IMPOUNDS A GREAT LAKE

An artist's conception of the dam and lake as they will appear when completed. This drawing visualizes the immensity of the work, the power house and transmission lines appearing small by comparison with the dam over the top of which a highway will be constructed

A Mountainous Earthen Dam

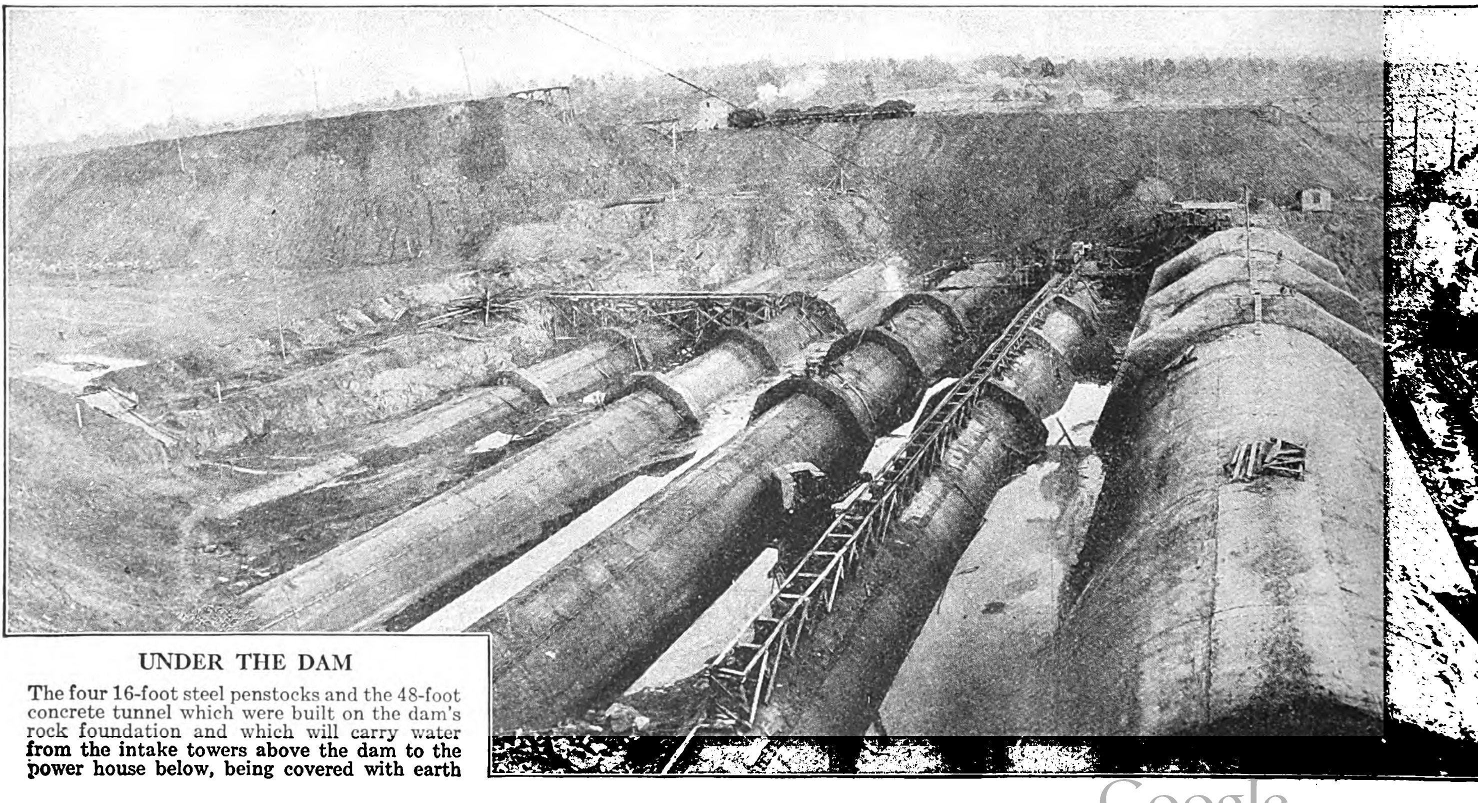
Gigantic Earth-fill Dam In South Carolina, One of the Largest In the World, Will Be a Part of Huge Hydro-electric Project

WHAT will be the largest earth dam in cubical content in the United States, is steadily rising to its mountainous proportions on the Saluda River, 10 miles from Columbia, South Carolina. This great dam is being built by the Lexington Water Power Company, subsidiary of the General Gas and Electric Corporation, New York, for hydro-electric development of 300,000 horsepower.

The dam will be 208 feet high, nearly a mile and a half long, and a quarter of a mile thick at its base. It will contain 11,000,000 cubic yards of earth fill and is now nearly one third completed. A concrete highway, part of the state highway system, will be built across the top of the dam.

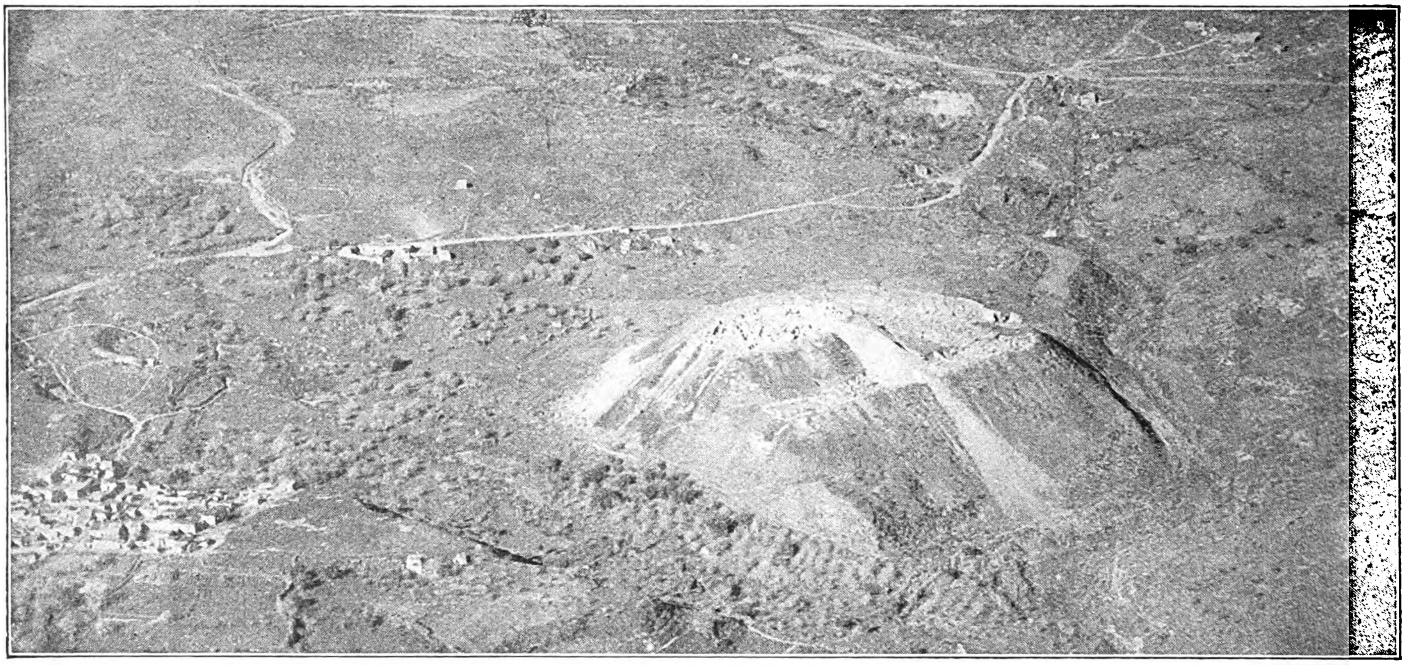
The dam will create a lake 41 miles long and 14 miles wide at its widest point, with a shore line of 520 miles. It will cover 53,700 acres of land and, when filled, will contain 750 billion gallons of water—sufficient storage to keep the power station operating over a six months' period of complete drought.

The hydraulic fill system is being used in building the dam. Two separate loose earth dams have been built to a height of 75 feet, 1000 feet apart, across the valley. The area between the two fills will be pumped full of water to a depth of 25 to 30 feet, creating a segregation pool, which will be maintained by pumping in enough water to take care of evaporation and seepage. Streams from monitors pumping 750 gallons of water per minute at a velocity of 125 feet per second will be directed against the



UNDER THE DAM

The four 16-foot steel penstocks and the 48-foot concrete tunnel which were built on the dam's rock foundation and which will carry water from the intake towers above the dam to the power house below, being covered with earth



BEISAN FROM THE AIR

Here the University of Pennsylvania Museum has maintained an archeological field expedition for seven years. Beisan is the Biblical Beth-shan and is 90 miles north of Jerusalem. The modern Arab town is shown on left. The expedition house is in right upper corner

Exploring the Biblical Beth-shan

For Thousands of Years, Invading Armies Stormed This Little Hill at the Crossroads of Palestine

By CORNELIA H. DAM
Head Docent, The Museum of the University of Pennsylvania

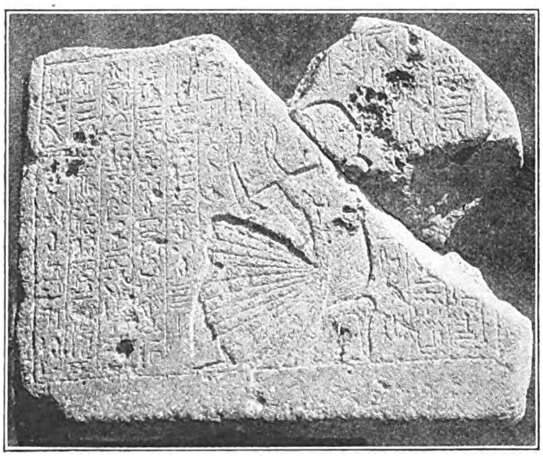
NINETY miles north of Jerusalem, where the Valley of Jezreel drops into that of the Jordan, stands the ancient stronghold of Beth-shan, the Scythopolis of the Greeks. Situated as it is at the crossroads of ancient highways from north to south and from east to west, it was from remote antiquity down to Crusader times the key to both military and commercial operations in northern Palestine. Inevitably, therefore, every invading people—Egyptian, Hittite, Philistine, Israelite, Persian, Roman, Byzantine, Arab, and Crusader—stormed this little hill in the military campaigns that beat incessantly against the city walls of Palestine throughout her history. Each succeeding people left behind material traces of its occupation of the town, buried in the debris of battle and decay, awaiting the time when the spade of the archeologist should uncover them to help him tell the story of man's past.

ENCOURAGED by the knowledge of the town's eventful history, braving pestilential heat and the worst malarial belt of Palestine, an expedition maintained by the Museum of the University of Pennsylvania has been at work upon the "tell" of Beth-shan for seven seasons, with results that have been generally acclaimed by archeologists as the most important in that country for many years.

Overshadowing other discoveries on the site, in historical importance and in general interest, has been that of a series of temples which, each built upon the ruins of the last, crowned the citadel successively from 1500 B.C. until medieval times.

Beneath the medieval, Byzantine, and Gracco-Roman remains, the third level reached belonged to the Philistine-Israelite era, and revealed the two Philistine temples mentioned in the story of Saul and David, the "Temple of Dagon" and the "House of Ashtaroth." (I. *Samuel*, xxxi., 10; I. *Chronicles*, x., 10.)

Brave, King Saul defied the warlike hosts of the Philistines and with his little army went down to heroic defeat before them on the slopes of Mount Gilboa.



EGYPTIAN STELE
Dedicated in the temple of Dagon by a local Egyptian official, Amen-em-Apt. See the text on page 313

> "And it came to pass on the morrow, when the Philistines came to strip the slain, that they found Saul and his three sons fallen in Mount Gilboa.
>
> "And they cut off his head, and stripped off his armour. . . And they put his armour in the house of Ashtaroth: and they fastened his body to the wall of Beth-shan."

The account in I. *Chronicles* says "They put his armour in the house of their gods, and fastened his head in the temple of Dagon."

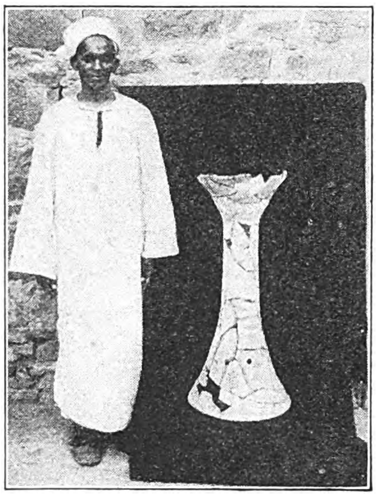
News of the national calamity was brought to David while he was in camp in Ziklaq, and the young poet-warrior sallied forth to wreak vengeance upon his arch enemies, the Philistines. He captured their citadel of Beth-shan and destroyed it—how thoroughly could be read in the excavations, where mud brick walls had been baked red by the heat of the conflagration and charred and fallen timbers filled the rooms to a depth of three feet.

Both the temple of Ashtoreth and the temple of Dagon showed in their plans and general character a strong Egyptian stamp, having been built during the reign of Rameses the Great, about 1283 B.C., when that warlike Pharaoh was using the town as a military post from which to operate throughout his Syrian empire.

THE two temples, built side by side and separated only by a corridor, occupied the southern slope of the citadel, just within the fortification walls. The smaller and northern one was identified as the "house of Ashtaroth," the larger and southern one as the temple of the Canaanite god, Resheph, the Dagon of the Philistines. Both had plastered walls of mud brick, floors of beaten earth, and roofs of wood. Windows, if there were any, must have been simply narrow slits high in the wall, such as are found in various Egyptian buildings of the same period.

In the center of the rectangular hall, about 54 feet long and 30 feet wide, which appeared to be the main feature of the temple of Ashtoreth, had once stood four columns of which the basalt bases alone remained. Near one of them was found part of an Egyptian stele dedicated to the goddess Antit (Ashtoreth) who is here depicted wearing a long white robe and, on her head, a plumed crown. Above her is written, "Antit, queen of heaven, mistress of all the gods."

The temple of Resheph or Dagon was larger and somewhat more elaborate in plan than that of Ashtoreth. The great central hall, 73 feet long and 26 feet wide, was divided into three aisles by a double row of columns, three on each side. Beneath the stone base of the central column on either side was found a foundation deposit, on one side of gold and silver, on the other of silver, consisting of rings, bracelets, earrings, wire, and nuggets of the metal. The altar, which probably stood at the eastern end of the hall, was destroyed by a Byzantine reservoir which later was sunk through that end of the temple.



HOLLOW TEMPLE OBJECT
This is a hollow cult object of pottery from the temple of Mekal. It is probable that incense was burned in it. Note holes near base

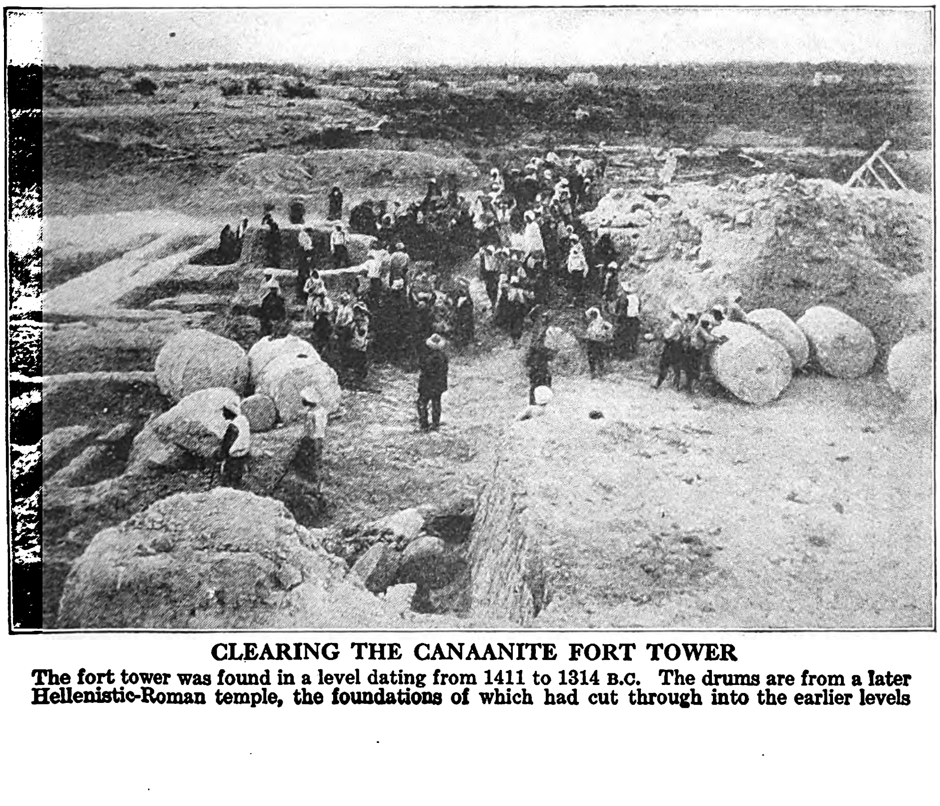
In this temple too was found a contemporary representation of the deity to whom the building was dedicated. It is a beautifully cut cylinder-seal of Rameses the Great, showing the Pharaoh wearing his war helmet, shooting arrows at two captives who are tied up before a Canaanite fort-standard. Facing the king is the Canaanite war-god Resheph wearing a conical crown with the head of a gazelle attached to it. In his left hand he holds a scimitar and in his right the ankh-sign; that is, he holds in his two hands life and death.

But the most extraordinary and interesting of discoveries in this temple was that of an inscribed stone doorjamb which gives us the name, titles, and a portrait of the actual builder of the temple, so that now for the first time in the history of excavation we have the name and portrait of the builder of one of the Canaanite temples mentioned in the Bible. He was Rameses-Wesr-Khepesh, and his portrait represents him in Egyptian headdress and a voluminous linen robe, his hands raised in adoration, presumably to Resheph. His titles read "Overseer of soldiers, commander of the bowmen of the Lord of the Two Lands (i.e., Pharaoh), royal scribe, great steward, Rameses-Wesr-Khepesh, the son of the fan-bearer at the right hand of the king, chief of the bowmen, overseer of foreign countries, Thothmes." He must have been a noble of considerable position temporarily in charge of the military post at Beth-shan.

Most important evidence as to the nature of the cult of Ashtoreth and the rituals of her worship at this period comes from the various cult objects which were found in the storerooms of Dagon's temple and in the temple of Ashtoreth itself. Along with fragments of vases, lamps, bowls, and tools of bronze were found certain curious objects of pottery which may be divided into four main classes: (1) Cylindrical stands, (2) Shrine-houses, (3) Sacred "boxes," and (4) *Kernoi* or hollow rings with small cups or vases attached at intervals, a type of sacred object common among the Aegean people.

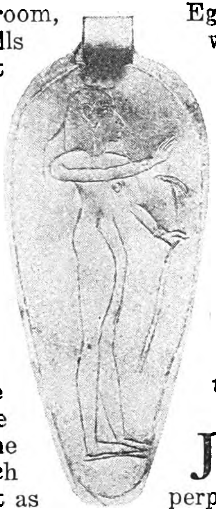
THE cylindrical stands resemble tall vases open at both top and bottom, decorated with serpents and doves in low relief, or painted with geometric designs, gazelles, or sacred trees, all symbols of Ashtoreth. Mr. Alan Rowe, director of the expedition, after making a thorough study of similar objects represented in ancient Babylonian art, concludes that they were undoubtedly used in sacred rites associated with agriculture and were, in fact, but types of the famous "Gardens of Adonis" of classical writers. These "gardens" were pottery vessels or baskets filled with earth in which plants were forced by frequent watering and exposure to the sun, a rite of sympathetic magic to promote the renewal and growth of vegetation through the aid of an agricultural deity.

Directly below the temple to Dagon, or Resheph, of Rameses II., was uncovered one built by his great predecessor, Seti I. about 1300 B.C. It dif-



CLEARING THE CANAANITE FORT TOWER
The fort tower was found in a level dating from 1411 to 1314 B.C. The drums are from a later Hellenistic-Roman temple, the foundations of which had cut through into the earlier levels

fered somewhat from the later temple in plan, having an entrance court outside the main hall which here was apparently roofed over only at the northern end, the southern being left open to the sky. Behind a great altar at the northern end, and up a low flight of steps was a little upper altar room, the floor and probably the walls of which were painted bright blue, the color of heaven.



A GOLD PENDANT ➤

The illustration shows the goddess Ashtoreth with headdress and sceptre. The modeling of the figure, while archaic, shows considerable artistic feeling in its execution

Quantities of flour found near some brick ovens in one of the rooms near the temple suggested offerings that were made to the goddess, as did the jars filled with sesame seed which probably in ancient times, just as today in Palestine, was used for making oil, for sweets, and for sprinkling upon biscuits. "Seest thou not," cried Jeremiah, "what they do in the cities of Judah and in the streets of Jerusalem? The children gather wood, and the fathers kindle the fire, and the women knead their dough, to make cakes to the queen of heaven. . . ." (Jer. vii.: 17-18).

The remains of the Seti I. temple having been surveyed, planned, and mapped, were then removed to uncover those of a similar, still earlier, fourth temple, which evidently belonged to the reign of Amenophis III., about 1400 B.C. Figurines of Ashtoreth again identified the deity to whom it had been dedicated. The size and plan of this temple were almost identical with those of the Seti temple, the latter having evidently been a rebuilding of the earlier one.

AMONG the objects which were found in this temple several were of first importance to archeology: from a foundation deposit below the altar steps cylinder seals and a faience finger-ring of Amenophis III. helped to identify the builder of the temple, while a fine Syrian dagger of bronze, a magnificent Hittite axe-head in the shape of a hand outstretched (the best one of its kind ever discovered), and a basalt model throne and model altar, both of typical Cretan design, testified to the cosmopolitan character of the population of Beth-shan 3300 years ago and to the number of nations over which Ashtoreth even then held sway.

For the scientific world, however, by far the most important discoveries were those of last season, when, at a depth of 50 feet below the top of the tell, and in the stratum directly below those of the other temples, were found the earliest Canaanite sanctuaries which have yet been discovered in Palestine.

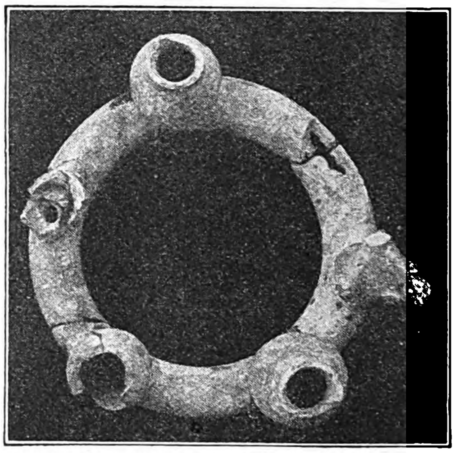
These two, which bring the number of Canaanite temples excavated at Beth-shan up to six, although they belong to the reign of Thothmes III., about 1500 B.C., unlike the later temples, have no connection with any Egyptian archetypes, and are wholly Canaanite in origin. The larger and southern one was dedicated to the god of Beth-shan, the smaller and northern one to the goddess.

From an outer court in the southern temple the visitor passes to an inner court where stand three low brick tables for offerings, upon which were probably placed those portions of meat offering which were not offered up in the inner sanctuary.

JUST to the south of them, Mr. Rowe found the socket for a perpendicular pole upon which the carcass of the sacrificed animal was dressed, while near by were lying a sacrificial dagger of bronze, the shoulder blade of a young bullock, and a huge bronze pendant, evidently one of the ornaments with which the live bull was decked for sacrifice.

Turning southward and passing by the offering tables and the pole upon which the sacrificial carcase hung, the visitor enters a large corridor which runs across the southern end of the temple and turning north again opens on the eastern side into a room which proved to be of the greatest interest, for it contains the *mazzebah* or sacred stone emblematic of a Canaanite divinity. It is a roughly hewn cone-shaped block of basalt set upon a stone foundation of the same material. The floor around it is of brick, not earth as in the rest of the temple, and sunk in this floor just in front of the column is a basalt libation cup to collect the blood offerings that drained off the column.

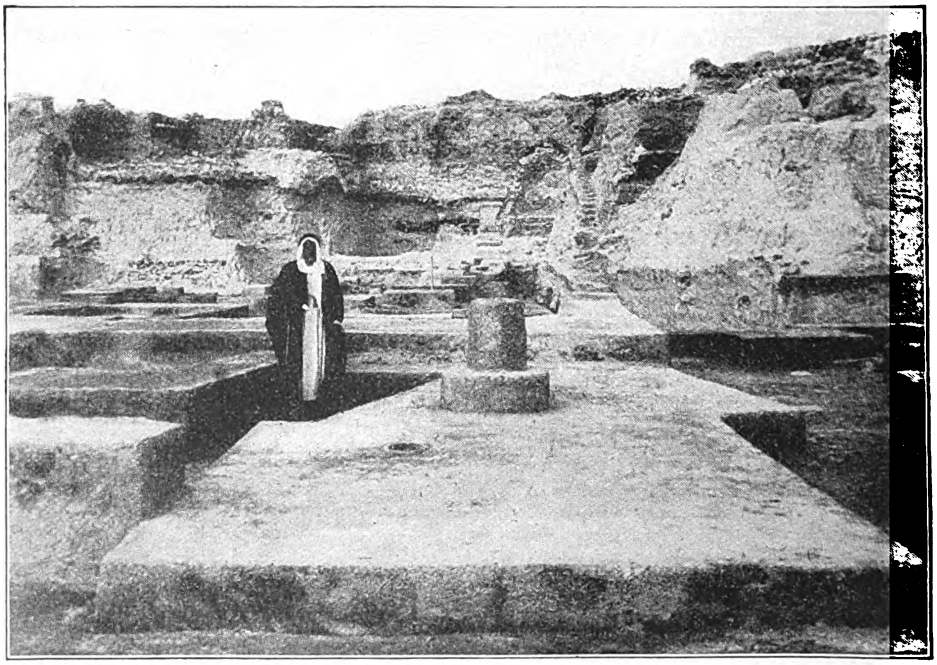
The rooms and corridors so far described constituted that part of the temple to which the laity was admitted. Beyond them, filling the northwestern and larger part of the sacred area are two rooms, the inner sanctuary and, south of it, adjoining, the room of sacrifice. These were reserved for the priests.



HOLLOW POTTERY RING

Kernos, or sacred object consisting of ring and five cups or vases. Use uncertain, but possibly intended for flowers. See text

The room of sacrifice was easily identified by the great brick altar on the northern wall which separates this room from the sanctuary. The altar itself was so placed that it could be approached from either room. On top of the altar is an L-shaped channel, by which the blood of sacrifice was conducted to an outlet in the side of the



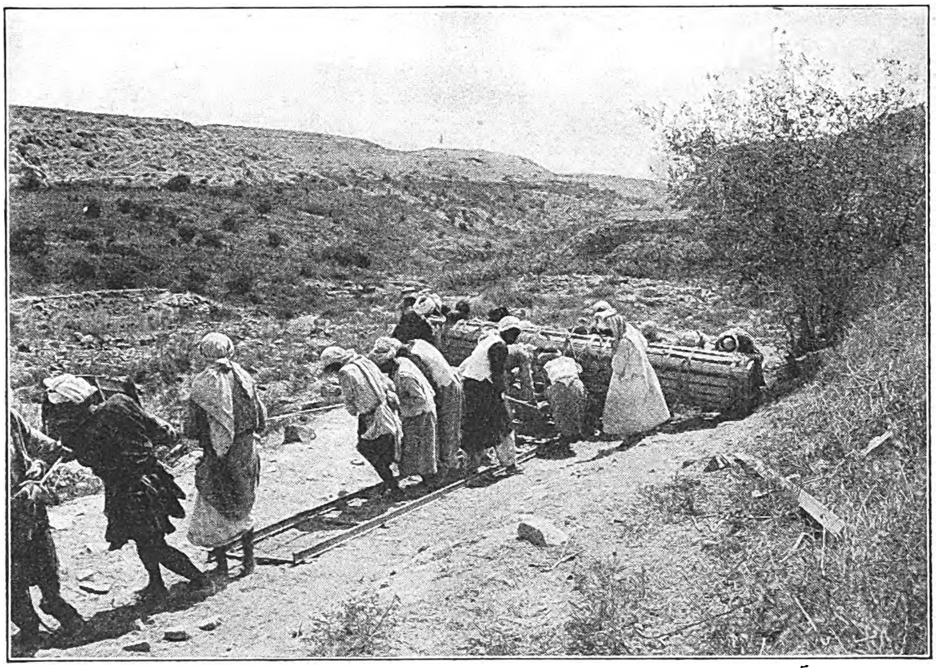
CONICAL EMBLEM OF DEITY

It is the "mazzebah," or sacred conical stone which was emblematic of a Canaanite deity, as it appeared at the eastern end of the great corridor of the temple of Mekal altar. In one side of the channel is a hole for a wooden peg by which the victim was tethered on the altar. Nearby were lying the horns of a young bull, doubtless the last one that was sacrificed in the temple and the same one whose shoulder blade was found in the outer court.

The main feature of the inner sanctuary is the central altar, which was approached by three steps on its southern side. On a low wall which projects from it on the right is a shallow bowl for blood offerings. The cooked meat offerings were probably placed on a smaller low stone altar which stood a few feet in front of the steps of the main altar. The main altar was most likely once adorned with the various offerings and sacred objects which were found lying around it.

THE offerings of jewelry include a magnificent amethyst scarab of Sesostris I., 1950 B.C., which is so far as we know the only one of its kind in existence. The cult objects are a pottery figurine of Ashtoreth, a model altar of Cretan design, a gold-covered figurine of a god, a cylindrical stand like those already described from the other temples, and, most decorative of all the cult objects yet discovered, two fine painted pottery vases.

Fragments of plaster found here and there suggest that the walls and floor of the temple may have been painted the "blue of heaven" as was the upper altar room in the Seti temple; we cannot be sure. But it does seem certain that the outward appearance of these earliest temples was not like that of the solid walled and roofed temples of the later period, for on the low walls of both of Thothmes' temples were small brick pedestals which seem to have been for the purpose of holding the supporting posts of a board or wicker enclosure that was open to the sky.



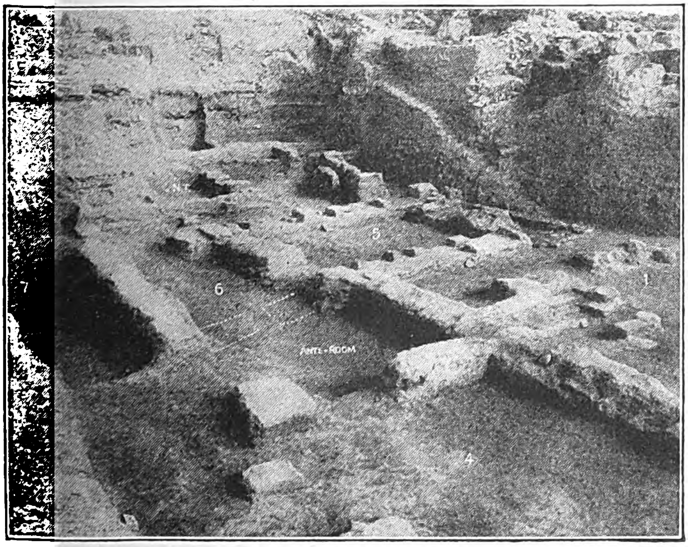
A SHORT RAIL SECTION HELPS

A small section of contractor's rail serves to lighten the labors of the Arab workmen. They are removing one of the Byzantine columns carefully protected for shipment to the Museum

In some debris near the *mazzebah* room was found the inscription which gives us the name of the god of the temple, a new god in the Pantheon of the East. It is on a little Egyptian stele which probably once stood near the *mazzebah* and is dedicated to "Mekal (or Mekar) the god of Beth-shan," by a builder named Amen-em-Apt, and made by his son, Pa-Ra-em-Heb. Mekal's picture and name appear here for the first time in history.

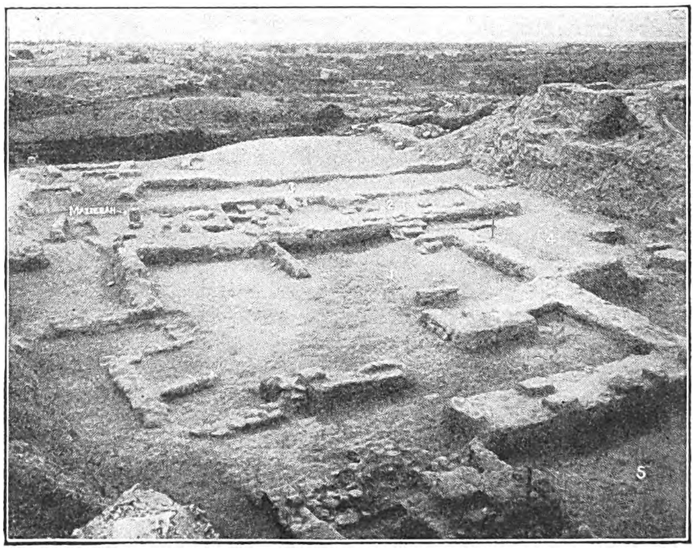
The northern temple on the Thothmes III. level, which is not yet entirely cleared, seems to be very like the uppermost "House of Ashtaroth" which was found in the Rameses II. level and must have been dedicated to the female counterpart of Mekal, some early form of Ashtoreth. Various serpent cult objects indicate that the center of a great Palestinian serpent cult was once located at Beth-shan and that even the traditional name of the city, Beth-shan, or "House of Shan" may be derived from that of the old Sumerian serpent deity Shahan or Shakhan, who may, therefore, have been the original deity worshipped in this city.

What this season's dig may reveal, when the temple areas shall have been completely cleared, is a matter of anxious conjecture on the part of all who are following the story of the expedition, for the importance of the discoveries made heretofore in the upper levels makes us confident that at the early level now reached we may find considerable material entirely new to Palestinian archeology and to the history of religion.



NORTHERN PORTION OF SOUTHERN TEMPLE

The northern temple is seen partly excavated and is marked "N T." "1" is the inner sanctuary, "Mekal Temple," "6" is the corridor leading to northern temple, and "7," the outer entrance court

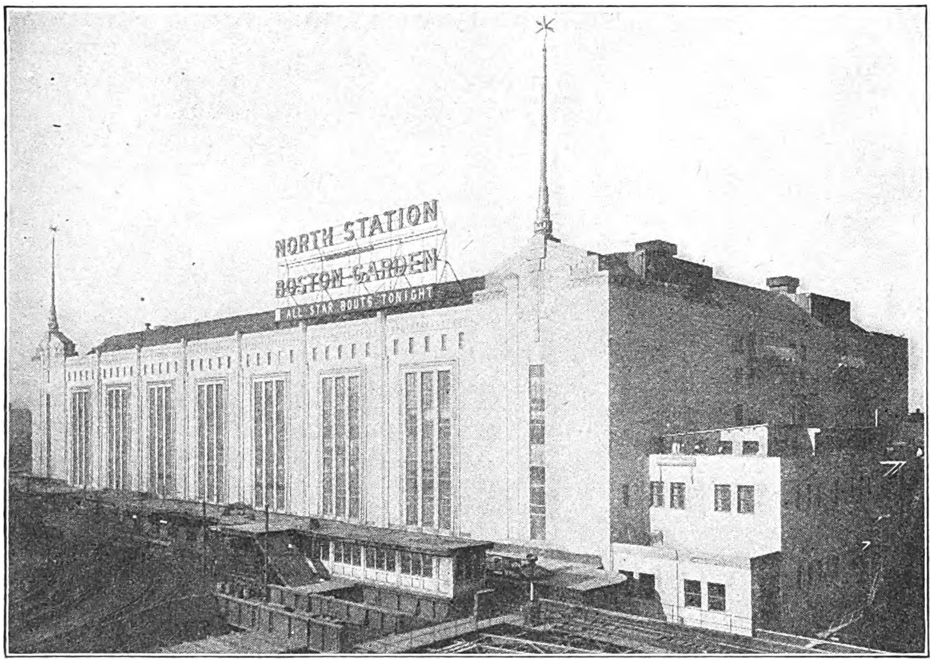


CENTRAL AND SOUTHERN PORTIONS

"1" is the room of inner sanctuary, "2," altar of sacrifice, "3," corridor leading to "mazzebah" room, "4," entrance court with three offering tables, and "5," room north of the inner sanctuary

Boston's New "Madison Square Garden"

How a Railway Station and an Auditorium Were Combined to Double the Use of Land



BOSTON'S NEW NORTH STATION AND "GARDEN"

In Boston's congested "North End" a new railway station was imperative, so a double-function edifice was erected combining all the features of a great terminal, with amusement center atop. The plan was conceived by the Boston and Maine Railroad

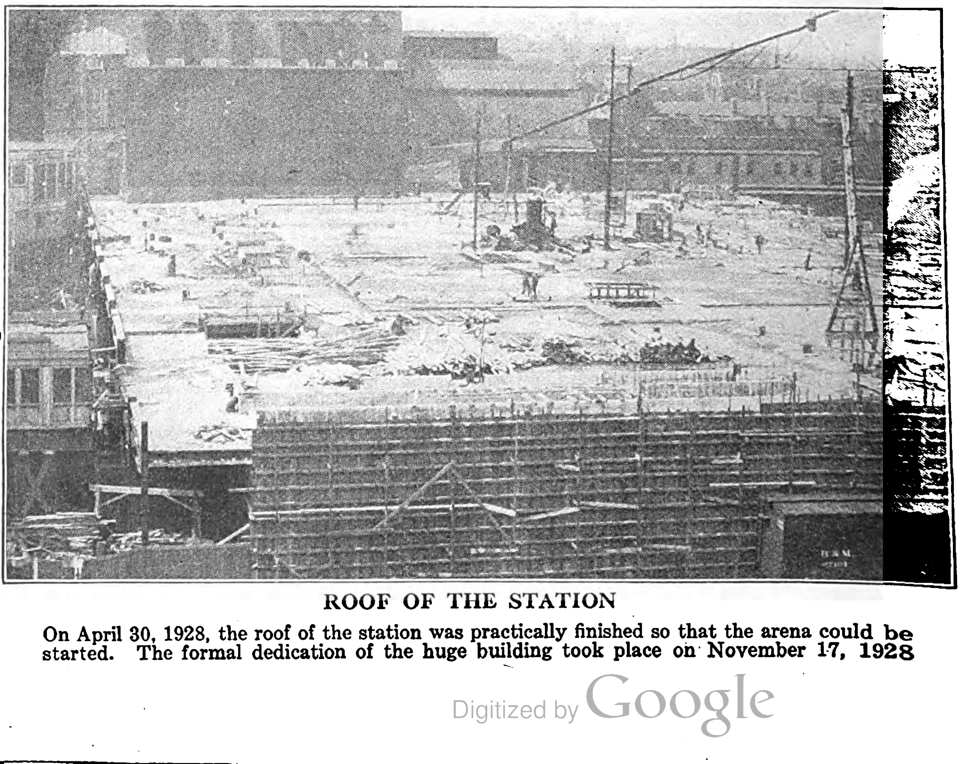
THE romance of engineering has many facets. A bridge, a tunnel, a skyscraper may be filled with romance but when we have romance and history; a station and a sports arena superimposed; all combined we have a most interesting proposition. The new "North Station" of the Boston and Maine Railroad in Boston has just been completed and we are able to give our readers a few salient facts.

Reference to old 18th Century maps shows that a considerable body of water was impounded at the south end back of Beacon Hill to supply power for a water mill. To raise the level a causeway was built to separate the 70 acre millpond from the Charles River. This causeway was built of masonry. In time the mill pond was filled up to the causeway, which then became a transitory boundary. Then came the railroads and Causeway Street at the water's edge was the natural location for the terminal stations of the Lowell, Fitchburg, Eastern, and Boston and Maine Railroads crossing the Charles River by bridges. There were originally three stations, not connected in any way.

IN 1894 the old North Station was built which was in use until the fall of 1928. When the new station was decided upon, naturally the old location afforded the most logical and economical site, so the problem was to take care of the large body of commuters, as well as passengers for long hauls without disturbing traffic conditions. Other roads than the Boston and Maine had met the problem, but never before, it is stated, had such construction speed been attained under similar conditions.

The traffic had become so great that the old North Station was totally inadequate, but there was no room to transfer this traffic to another location, therefore the work had to be done as far as possible without disturbing the regular flow of railroad travel, and it may be stated as a fact that not a passenger was injured or a train delayed during this large building operation. It naturally required great executive control to co-ordinate all of the work of construction with a view to efficiency and safety.

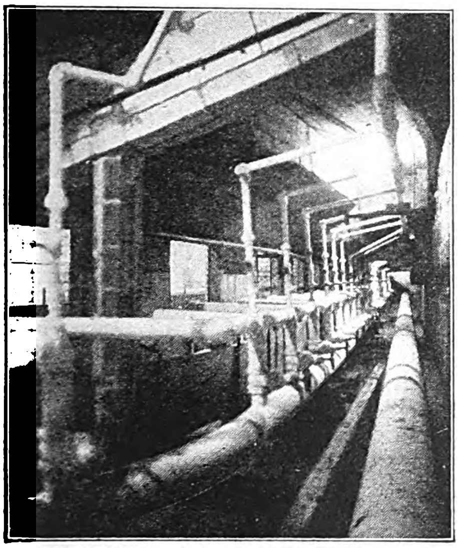
CONSTRUCTION was made doubly difficult on account of the tons of stone of the old wharves and also because the piles of the old station could not be removed. The contractors drove new concrete piles without disturbance to the old wood piles and thus secured the proper footings for the double-use building. The architects were Funk and Wilcox Company, and Fellheimer and Wagner, associate architects. The designing engineers who also did the construction work were Dwight P. Robinson and Company, Inc. The first foundation work was commenced on December 5, 1927. The railroad ticket offices and station passageways were opened on September 1, 1928. The station was formally opened on November 14, and the "Garden" November 17. The station tracks were laid in their former location except for slight relocations to permit the in-



ROOF OF THE STATION

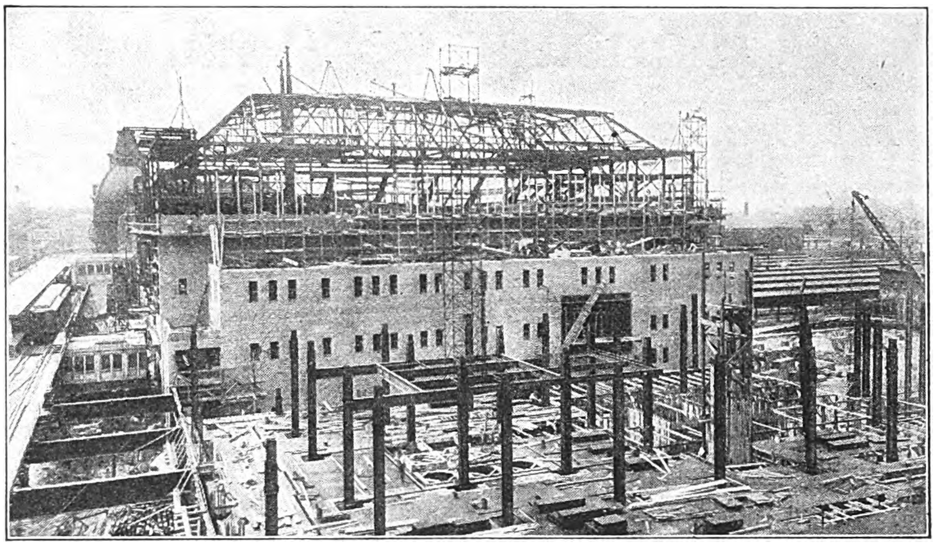
On April 30, 1928, the roof of the station was practically finished so that the arena could be started. The formal dedication of the huge building took place on November 17, 1928 stallation of baggage ramps between pairs of tracks to the mezzanine floor.

The ground floor and mezzanine floor are devoted entirely to railroad station purposes. The concourse is 62 feet wide and 400 feet long, extending across the railheads of 23 tracks. There are many offices and stores in the structure which help to sustain the financial burden. The structure rests on 1518 concrete piles. The ground area of the station, including entrance, is 100,000 square feet. The exterior of the building is designed in a modern style of architecture, a large pylon at each end marking the entrance, between which there are seven arched openings.



THE BRINE PIPE LINES

Brine is brought from 1000 feet away and circulates through 13 miles of piping



THE "GARDEN" CONSTRUCTION

Here we have the arena in the making. The clear span of the roof trusses is 175 feet. Photograph shows the condition of August first. First use of arena, November 17, 1928

The financial burden of the terminal was solved by a brilliant plan of erecting a sports arena as a part of the station building, so that one tract of land does the work of two. On the roof of the station is erected the arena measuring 110 by 245 feet, which is enclosed by a coliseum building 204 by 360 feet. The ground height from the arena floor to the roof truss is 67 feet.

The reason for a "Madison Square Garden" at this particular point seems very logical. It is at a terminus serving a vast section of heavily populated New England. It is also within walking distance of the principal business district and is served by a splendid subway and trolley system. It is very convenient on a winter's night to enter, without leaving the building, a warm coach to take you to Lawrence, Webster, Lowell, or Gloucester, or the subway to Cambridge.

A LOCATION for a place of amusement involving large bodies of spectators could hardly be improved upon. Access to the arena is obtained by exceedingly well designed ramps which would empty the structure in a few minutes. The seating capacity is 18,000 for boxing and 14,500 for hockey. The lighting is so good that photographs have been made with the normal illumination. Great attention has been paid to ventilation so that tobacco smoke can be instantly removed. A new product of vegetable fiber was used to cover the entire ceiling, with the result that the arena has wonderful acoustic properties. Even concerts can be held here.

The coliseum is called "Boston Garden" and the same kind of events take place as in the sister arena in New York. The floor can be flooded and frozen for skating and games of hockey. There is no danger of possible injury from any accident to the refrigerating machinery for the fluid for freezing is brought into the plant from an adjacent refrigerating plant. The ice floor contains 13 miles of 1½ inch pipe.

In general, the mechanical equipment for this coliseum has been planned to meet every known condition in connection with sports and various other assemblies, and the servicing of the plant has been carried out to a degree in excess of any similar project in the world.

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THE GARDEN IS DEDICATED

A big boxing carnival opened the edifice on Nov. 17, 1928. It seats 18,000 for boxing. The lighting and the acoustics are fine

THE FIRST HOCKEY GAME

Three days after the dedication the first hockey game was held, "Bruins *vs* Canadiens." The arena seats 14,500 for hockey

Quantitative Analysis of the Sun

The Ordinary Identification of the Chemical Elements on the Sun by Means of the Spectroscope Has Long Been Possible. The Newest Development Is Quantitative Analysis of These Same Elements

By HENRY NORRIS RUSSELL, Ph.D.

Head of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

ONE of the memorable moments in the experience of the amateur astronomer—if he has a real love of science—is his first adequate view of the solar spectrum. Even with the small spectroscopes which may be found in any laboratory of chemistry and physics the spectrum is a beautiful object, a brilliant band of light glowing with colors whose purity and intensity of hue cannot be matched elsewhere, and crossed by innumerable dark lines.

To the novice, the colors are likely to be the most impressive feature. The astrophysicist pays no more attention to them "than does the geographer to the colors on a map," as Prof. Young put it many years ago; for the lines themselves tell us a story so long and wonderful that many chapters of it have not yet been read.

Everyone knows some chapters of this story. The positions of the lines, for example, are characteristic of the chemical nature of the material which absorbs them. Every element in the Sun's atmosphere and every chemical component which can exist without decomposition there, in spite of the high temperature, has its own distinctive set of wavelengths for its lines; and so a very extensive qualitative analysis of the Sun's atmosphere is possible.

IN the revision of Rowland's Table of the Solar Spectrum, which has recently been published from Mount Wilson, no less than 57 of the elements have been identified by means of the spectrum lines.

Such an analysis by no means exhausts the possibilities of the study of spectrum line positions. Minute shifts of the lines are caused by motion in the line of sight, and it is an old story how these have led to the discovery of hundreds of double stars too close to be resolved by any telescope; also to fundamentally important determinations of the rate of motion of the Sun and the stars in space. Still other small shifts and doublings of the lines reveal the existence of powerful magnetic fields in sunspots, and of a weaker one surrounding the whole of the Sun's surface. And yet another shift in the spectrum of the faint Companion of Sirius has provided one of the most convincing proofs of Einstein's theory of general relativity.

With the wealth of attractive possibilities for investigation it is no wonder that astrophysicists have busied themselves for years with the precise measurement of the positions of the lines, both in laboratory spectra and in those of the stars.

The spectra, however, reveal more than such measure can detect. The *strength* of the lines has its own story to tell. In a general way this has long been recognized, and such elements as calcium, iron, and magnesium, which show very strong lines in the Sun, must clearly be abundant constituents of its atmosphere. Many of the elements which on earth are "chemical curiosities," such as gallium, germanium, and indium, show such feeble solar lines as to make it evident that they are rare on the Sun also.

THE passage from these rough qualitative statements to a real quantitative analysis of the atmospheres of the Sun and the stars is a matter of our own times. Within the last decade the advance of atomic theory has given us a clear understanding of the origin of the spectral lines upon which we have worked so long. The words "clear understanding" may sound strange when it is remembered that we are still very much in the dark as to the real nature of the atom—whether it consists of electrons, circulating in orbits, as now seems doubtful, or of electricity distributed in a more generalized fashion determined by the new "wave mechanics," or what not.

Fortunately for the student of the stars, the advance of our knowledge in many important fields does not depend on the solution of these recondite problems. We know enough already to say with confidence whether a spectral line arises from a neutral or an ionized atom; also how much energy has to be loaded into the atom to get it into a position to absorb the given line or to limit it. And we can calculate pretty securely what fraction of the atoms of a given element in an atmosphere of given temperature and pressure will be in any given one of the various possible states. Recognition of these facts has brought order out of chaos and shown how the widely different types of stellar spectra arise, not from differences in the chemical composition of the stars but from the different degrees of excitation of the atoms of different temperatures. In all this work the intensity of the lines is our main observational guide.

Until very recently we knew little or nothing about the actual number of atoms which were required to produce a spectral line of a given strength, but this too can be calculated, and the results are of much interest. It appears that when the number of atoms which are ready to absorb the given line increases, the strength of the line increases too; but only in proportion to the square root of the number of atoms at work. A line ten times wider than another will cut out just about ten times as much light from the solar spectrum, and may fairly be called ten times stronger. But it will require a hundred times as many atoms to produce it.

THE theory shows, too, that a spectral line should not be a sharp black band, but should decrease gradually in darkness from the center outward, fading into the continuous spectrum gradually. This agrees with the facts. The stronger lines of the solar spectrum are conspicuously "winged" by borders of gradually fading intensity. Ordinary photographs do not show this very clearly because they are taken for the purpose of measurement of the *position* of the lines; and the exposure, contrast of the plate, development and so on, are all chosen so as to get as "hard" a picture as possible and emphasize the darker center of the line.

When photographic processes that are adapted to reveal, rather than conceal, the real graduation of intensity are employed; when the plates are measured with the microphotometer which records accurately the opacity of the negative at each successive point near the line; and when the proper calibration is made to find from these measures the true intensity of the spectrum, it is found that even the narrower spectral lines have wings extending for several times their apparent width on ordinary photographs, while for the stronger ones these are very wide. For the familiar *D* lines of sodium, for example, the width across the wings is more than half the interval between the lines, and the great *H* and *K* lines of calcium in the violet actually run together.

From the curves which show how the intensity falls off in these wings at different distances from the center of the lines, it is possible to calculate the actual numbers of atoms which are at work in producing the line. Some very interesting work of this sort was done last year by Dr. Unsöld, a young German physicist at the Einstein Tower at Potsdam which was designed for solar observations. According to the quantum theory of spectra (confirmed fully by observations) just twice as many calcium atoms should be concerned in the absorption of the *K* line as act to produce the *H* line. The measured widths of these lines are in the ratio of 1.4 to 1; that is, proportional to the square roots of the number of atoms at work, as they should be. The same thing happens for the sodium lines, for the aluminum lines in the violet, and in other cases; affording a good test of the theory.

FROM these measures Dr. Unsöld finds that the number of sodium atoms which are at work on the *D* line is 2.6 x 10^{16} (or 26,000 million millions) above each square centimeter of the sun's surface. For the aluminum lines the number is 7 x 10^{16}; for the *H* and *K* lines which are obviously far stronger than any others in the spectrum, 2300 x 10^{16}. These are huge numbers but they look different when you remember that the number of molecules in a single cubic centimeter of air under standard conditions is 2700 x 10^{16}—larger still.

The number of calcium atoms just calculated refer to those which have lost an electron and are ionized. The lines of the neutral calcium are much weaker and Unsöld finds that the number of atoms producing them is 3.4 x 10^{16} per square centimeter. Even at the high temperature of the Sun, such a great preponderance of ionized atoms can occur only if the pressure and density are very low, so that an atom which has lost an electron has a poor chance of picking one up again. Unsöld calculates that the pressure, so far as it originates from the motion of the electrons, is only a millionth part of our ordinary atmospheric pressure. The total pressure, including that arising from the gaseous atoms, may perhaps be 10 or 20 times weaker, but it is evident that the Sun's atmosphere is a very tenuous affair.

To make such exact measurements of the widths and contours of spectral lines is a laborious task, demanding powerful instruments. For the great mass of weaker lines a quicker method is desirable. This can be derived with the aid of the quantum relations of which we spoke a moment ago. There are many groups of lines called "multiplets" in the spectrum in which the relative numbers of atoms which are at work can be calculated, and in some cases it is found that more than a thousand times as many atoms will be absorbing one line than its neighbor.

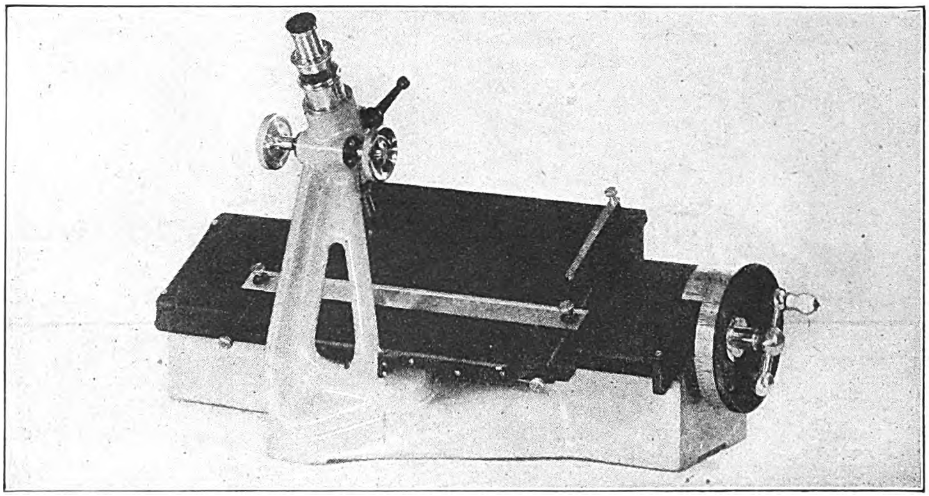
BY utilizing such cases it is possible to calibrate Rowland's arbitrary scale of the intensities of spectral lines and find the relative numbers of atoms which produce the lines to which he assigns different ratings. Hundreds of sets of these are available, and good results can therefore be obtained.

The results of such a calibration made here last spring by Dr. Adams, Miss Moore, and the writer, show that the numbers of atoms involved in the production of the different lines vary enormously. The faintest lines which can be seen on ordinary stellar spectra photographed with moderate dispersion are of about the intensity which Rowland called 1 on his scale. To produce such a line requires 2 x 10^{13} atoms per square centimeter—less than a millionth part of the number which produce the *H* and *K* line, or of the number of molecules in a cubic centimeter of air. In the solar spectrum, which can be photographed with powerful instruments, lines can be detected which result from the action of less than 1 percent of this number of atoms.

When a few more years of work of this kind have been done we should be in possession of the quantitative analysis of the atmospheres of the Sun and the stars. We ought then to have solved some of our present problems—and doubtless have a greater number of new ones to solve.

Some of the results obtained at the very start are striking enough; for example, the calcium lines are the strongest in the whole solar spectrum. Some other elements may be as abundant but have their spectral lines far in the ultra-violet where we cannot get at them. Allowing for this, it seems a fair guess to say that probably between 1 and 10 percent of the Sun's atmosphere consists of calcium vapor. It then follows from what has already been said that the whole amount of gas in the sun's atmosphere amounts only to enough to make a layer of the density of common air somewhere between ten centimeters and one meter thick, covering the Sun's surface.

AT first consideration it seems incredible that so little stuff should produce the host of lines in the solar spectrum. But if we set up an arc in the laboratory and feed it with common salt or get sodium into it in any other way the *D* lines will be found to be self-reversed, the cooler vapor in the outer part of the arc absorbing a dark center from the broad, bright line given by the hotter core. The sodium lines thus produced in a thickness of a fraction of an inch of vapor are often much stronger than those in the solar spectrum. This fact was observed by Sir Norman Lockyer more than 40 years ago. He drew the conclusion then that the solar atmosphere must be exceedingly rarefied, and this common sense conclusion is confirmed by the most modern work.—*Mount Wilson Observatory, February 5.*

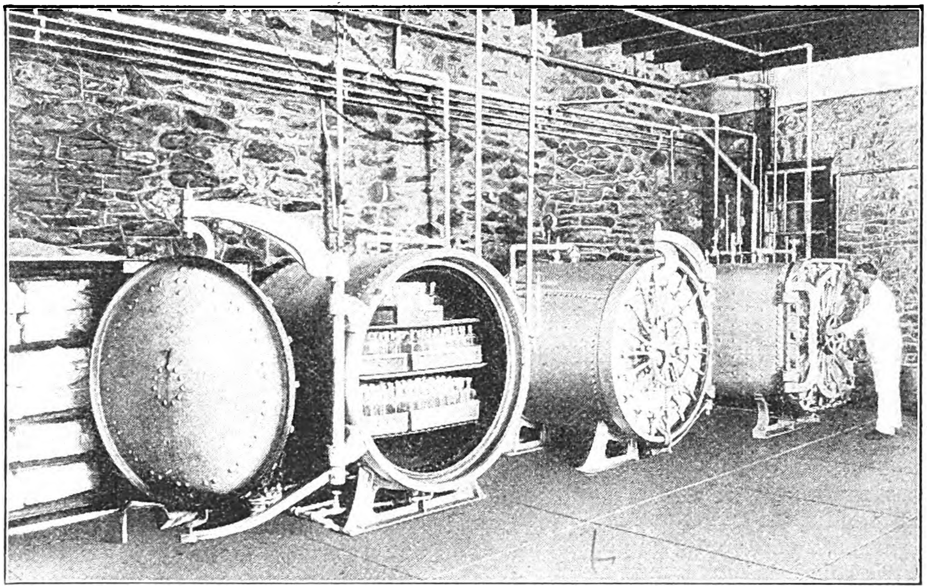


Courtesy Adam Hilger, Ltd.

HOW SPECTRA ARE MEASURED

The spectrogram is clamped to the table, which may be moved under the fixed microscope by means of a micrometer screw. This arrangement permits accurate measurement

¶ *In an early issue Dr. Paul R. Heyl of the Bureau of Standards will give the readers what he has so often given them—something to think about. The thought-provoking article is entitled "The Strangest Thing in Physics."*



All photographs courtesy H. K. Mulford Company

STERILIZERS USED IN PREPARATION OF SERUM

A battery of sterilizers for purifying containers, culture media, and instruments to guarantee that the serum does not become contaminated with harmful bacteria or other foreign matter

jected into the horse at regular intervals over a period of eight to twenty weeks. Some horses do not prove to be good antitoxin-producers, while others may produce antitoxin for years.

After the horse is highly immunized it is led to a bleeding room where an average of nine quarts of blood is drawn from its jugular vein. After the corpuscles settle, the pure serum is drawn off and concentrated by the ammonium sulfate method. In this form it is known as globulin. It is then filtered through porcelain, tested for sterility, toxicity, and unit value, and placed in glass syringes.

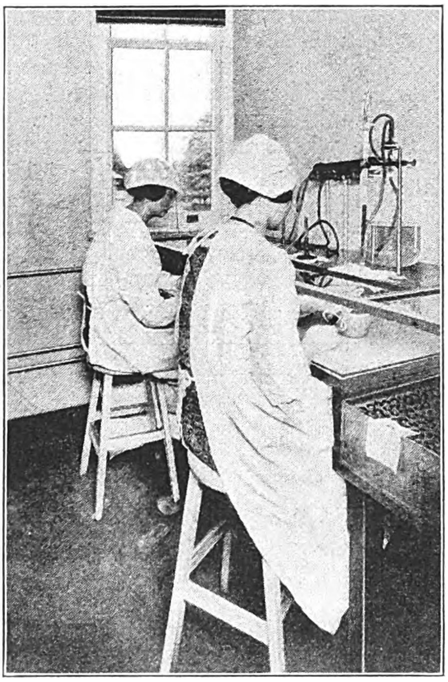
The story of Pasteur's work on the cure of rabies is too well known to be repeated. A more recent development is the vaccination of dogs against rabies. This method was developed in India, by necessity, for an English army post found it vital to have some kind of protection against the many stray dogs which infested the district. Later the method was used to overcome a frightful epidemic in Tokyo. The inoculation of a dog against rabies is done in a single, simple operation, and is no more painful to the dog than similar inoculation of humans.

TESTING ANTITOXIN

Cleopatra used slaves to test her snake poison; now guinea pigs sample antitoxin

It is within comparatively recent years that the battle between man and poisonous snakes has been equalized in favor of man. Today, antivenin, (*nearctic crotalidae*) is widely used as a North American anti-snake-bite serum. This provides protection against the bites of rattlesnakes, copperheads, and others. It is put up in handy syringes which can be carried by the hunter, traveler, or other person who is likely to encounter poisonous snakes, and should be administered immediately following the bite, or of necessity within 12 to 24 hours. Antivenin will retain its potency for a period of five years after manufacture.

In preparing snake-bite serum, venom from a moccasin or rattler is collected by letting the snake sink its fangs through a membrane-covered glass vessel. One moccasin will give from 30 to 40 drops of poison. Venom is then injected into horses in gradually-increasing doses over a period of about 16 months. Several days following the last injection of dry venom, the horse is bled. Three months after this bleeding the animal is ready for a repetition of the process. The anti-snake-bite serum is prepared from the collected blood, much as diphtheria antitoxin is made.

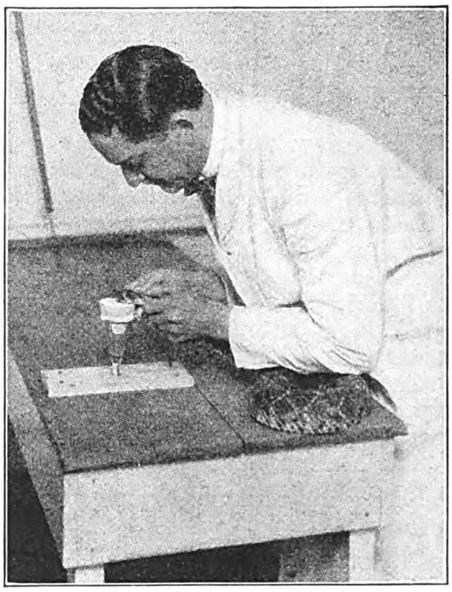


LOADING SYRINGES

Every sanitary precaution is followed when filling aseptic glass syringes with antitoxin

It is quite customary, in case of rattlesnake bites, to stimulate the heart and hasten the spread of the poison by drinking whiskey. When one is bitten by a snake the poison is injected directly into the blood, but the whiskey taken to counteract the poison goes into the stomach and can not be assimilated by the blood in time to offset the poison.

Of course, many more diseases are being combatted with sera, such as typhoid fever and tetanus. Some animal diseases, hog cholera for example, are likewise yielding to this type of treatment. It is hoped that eventually all human ills will be conquered by the serum method or by some equally effective means. When that day comes it would be a fitting tribute to erect monuments to the uncomplaining animals who sacrificed their lives that man's might be saved.



RATTLESNAKE POISON

Collecting the poison of rattlesnakes requires nerves as well as skill and the proper equipment

How People Differ Mentally

A Large Part of the Commonest Beliefs About Our Individual Powers and Limitations Are Not True

By **DONALD A. LAIRD, Ph.D., Sc.D.**
Director, Colgate Psychological Laboratory, Colgate University

THE individual was lost to psychology until the versatile English scientist Francis Galton tried to get the answer to some homely problems about human nature. Laws of memory and mental association that would hold for all human beings had engrossed the efforts of scientific students of human nature even before he unearthed certain spectacular findings. Laws for the operation of the senses had been thoroughly studied, but how one person differed from another had almost been neglected.

Probably these problems of how one person differs mentally from another are now arousing more interest than any other single group of problems in the field of psychology. Galton started the ball rolling in 1883 when his "Inquiries into Human Faculty" was first read by a scientific world bent upon finding how people were *alike*. The greatest applications of psychology in the schools and in industry, as well as in the mental clinic, are based upon how people differ rather than how they are alike. The laboriously unearthed facts in this rather new field are also of tremendous interest to the average individual.

This new field of "type psychology," "differential psychology," "individual psychology," "variational psychology," or whatever it may be called by the time this article is published, has revealed such interesting and even startling information as that contained in the following sentences:

THE slow worker is *not* the accurate worker. The old adage of "Slow but sure," or "Haste makes waste" has been found untrue—although it may be an excellent admonition for us individually when we are excited and attempt to work faster than usual.

The person with a good memory almost always has good reasoning powers also.

The hearing of the blind man is no more acute than that of the average person.

Practice in remembering the cards that have been played in a bridge game does not improve one's memory for names or faces.

Three or four people out of every hundred are unable to tell red from green; men have this defect more commonly than women do.

A mental age of twelve years is essential for one to drive an automobile safely; there are several hundred thousand adults in the United States alone who do not have this rating. (I know of no scientific data on "back seat drivers".)

The best time for learning is from about 16 to 25, but learning capacity at 40 is but little less than at 20.

PRACTICALLY every person has some marked weak spots in his mental equipment, regardless of how accomplished or skilled he may be.

Brain size or head shape has little to do with an individual's mental capacities.

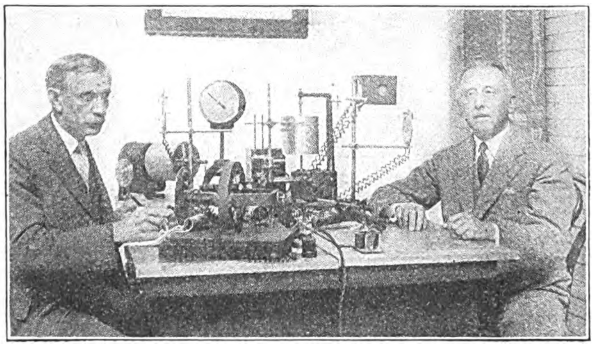
Individual differences in blood chemistry *may* have a close association with mental differences.

The charming after-dinner speaker may be a total failure at writing letters.

College professors do not possess as much intelligence as most people think they should have.

Some people are able to hear perfectly, except notes of certain pitches.

About five people out of every hundred have a peculiar sensory-linkage in which they associate certain colors with sounds they hear, known as "synaesthesia."



REACTION-TIME MACHINE
The time required to react to a signal is important in recording individual differences. This machine, devised by Dr. Knight Dunlap of Johns Hopkins, measures it

Some people can work with decreased fatigue after being irradiated with ultra-violet rays, while other people are more fatigued after the exposures to these rays.

Practice has the surprising effect of making the differences in mental ability between two people all the greater, the one who is more able at the start of the practice usually improving the more.

Some high school pupils can add simple arithmetic problems six times as rapidly as other pupils in the same classes.

Some women have three times as much strength in their right hand as other women have.

Some people can tap with their left hand only 20 times in half a minute, while others can tap 225 times in the same interval.

Brothers and sisters resemble each other mentally more closely than do unrelated boys and girls. Twins have a closer mental resemblance than mere brothers and sisters.

Probably there are not two people in the world with exactly the same mental make-up.

Environment may mould these individual differences somewhat, but it is not the cause, and does not generate the differences.

Country boys and girls grow more rapidly than children living in the city.

WE continue to grow in general intelligence at least up to age 18, and do not stop at 14 as early mental testers had thought. Perhaps we grow in this trait after the age of 18, but this is not yet definitely known.

Most of our sensory capacities improve with age. This has its disadvantages as well as its advantages, but not in the exception of pain. Here the sensitivity decreases as we get older.

Some children are able to make keener discriminations of musical pitch than the average adult.

Mental growth from childhood to maturity is not regular and uniform; some functions improve rapidly while others stand still; just when one high school girl may be improving in visual acuity another may be making no progress in this trait.

At about age 12 most girls have a pre-adolescent spurt in mental development, while boys do not have this spurt until they are a year or more older.

Sensory capacities mature sooner than those of the higher mental processes.

Brain cells are actually lost as we get older. By the time one is 75 there may be the loss of as much as 100 grams from the cerebrum.

Memory, originality, and initiative seem to suffer most with advancing age.

College men are better at arithmetical reasoning than college women.

The average woman has keener sensory acuity than most men; also, she usually excels in memory.

In proportion to their intelligence girls usually display better scholarship than boys.

A girl has to be more feeble minded than a boy in order to be taken to an institution for the feeble-minded for care.

It is possible that men vary more in their abilities than women do; that is, there may be more geniuses and "numb skulls" among the men.

The average white person grades about two mental-age years above the average colored person.

The negro is more like the white man in sensory capacity and muscular control than he is in the higher mental processes.

Whites mature at a later age than do negroes.

THE Hawaiians are probably the most intelligent of the brown races.

Nothing scientifically acceptable is known about mental differences among the white races.

One can be a skilled machinist without being particularly gifted intellectually.

Genius is *not* a close relative of insanity.

Age of parents does not appear to have a determining part in the abilities their children will possess.

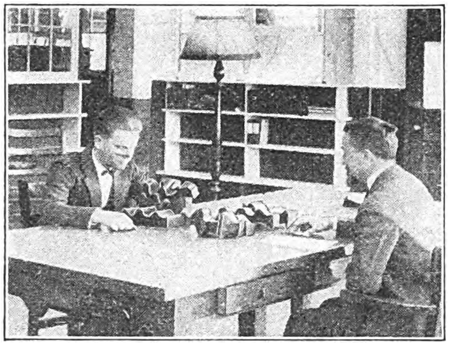
Children of large families are usually less intelligent than those of small families, although there is a tendency for men of great genius to be born in large families.

The oldest child is usually the most gifted in the family.

An unusually large percentage of delinquents and criminals are feeble-minded or closely border on mental disorder.

More intelligence is required to be a successful baker than a successful farmer.

City school children usually possess better mental abilities than country school children. The difference is not due to poorer teaching in the district schools of the country regions.



WIGGLY-BLOCK TEST

The task is to assemble all of the irregular blocks so that they form a perfect cube

The average intelligence of men is greatest in Oregon, and least in Mississippi; the difference is about two and a half mental age years.

The newer generations of Negroes are more intelligent, due to an admixture of appreciable amounts of white blood in their veins.

Pioneers have almost invariably been better equipped mentally than the people who stayed at home. It is not so much because the city offers better opportunities that more succeed there; it is partly due to the more intelligent young people leaving the country and coming to the city as present-day "pioneers."

Almost anyone can make an average success in any occupation.

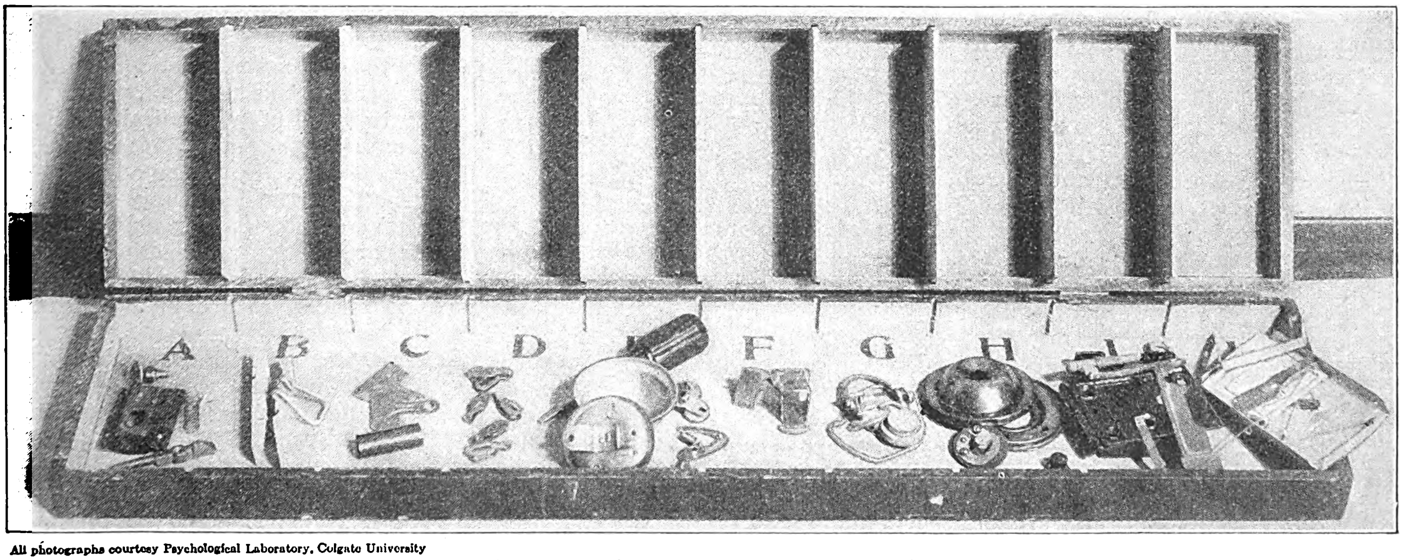
In most occupations the best person is three or four times as capable as the poorest.

The individual who is eminently successful may be a total failure in other occupations. Napoleon—who himself was a wretched speller—appointed the great mathematician Laplace to an important position in his cabinet, where the mathematician proved to be hopelessly incompetent.

IT is apparent from all these fragments taken from the results of recent psychological research that human nature is the most unstandardized thing on earth. And in this very quality of variability and difference probably lies the great fascination human nature offers for study or just plain enjoyment.

Galton, the Englishman, and James McKeen Cattell, the American psychologist, started the veritable deluge of laboratory work that has resulted in the discovery of the individual. This study of individuals is probably consuming the research activities of between 200 and 300 American scientists. Despite the amount of highly practical information that has been accumulated, the greater part of the work still lies ahead, beyond the peradventure of a doubt.

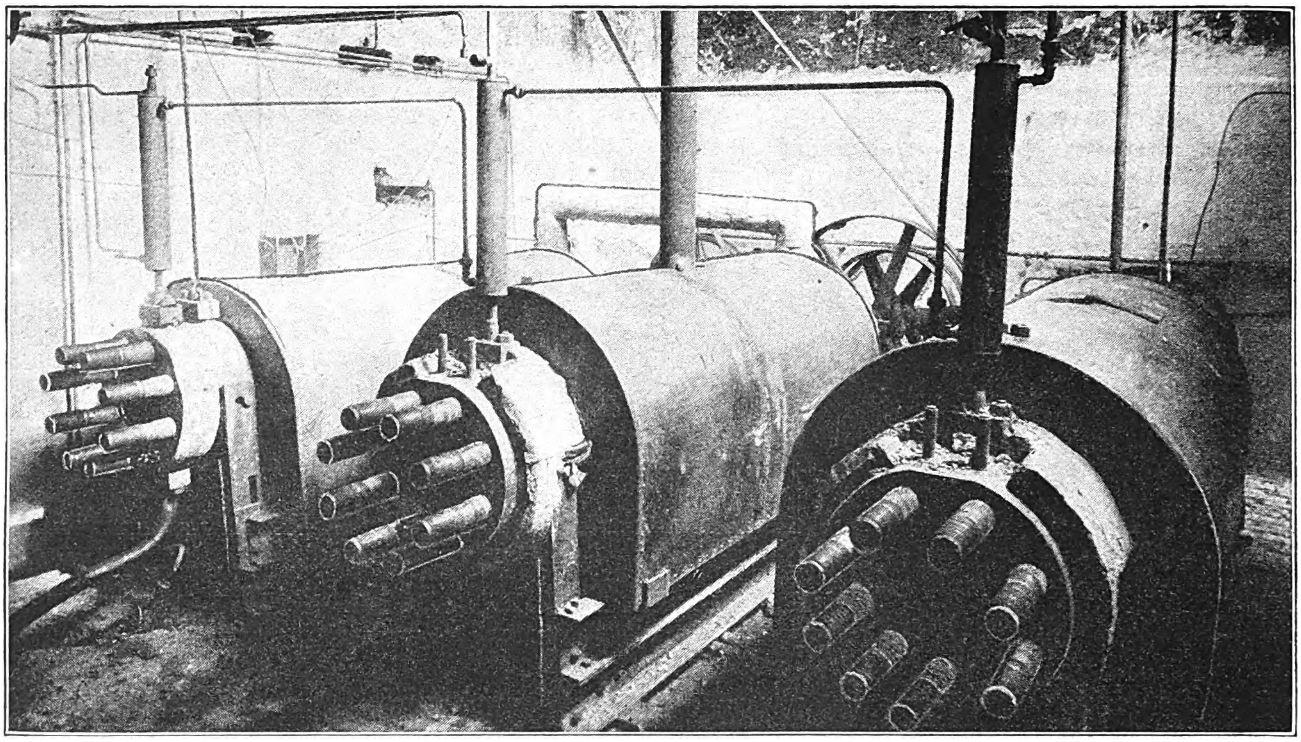
Department stores, factories, and taxicab companies have engaged specialists to study and select individuals who are predicted to be best adapted for various jobs, but I know of no enterprise which is attempting to make all human beings alike. Old-fashioned psychology implicitly assumed that we were all alike, and many laws were formulated from the arm chair, in precise language. These old laws have now been transcended by one great law—that no two individuals are exactly alike in their mental constitution. Each one is not a law unto himself, but each is himself. Yet we see many people who are trying to be like somebody else when their primary task should be to find out their real selves and how best to express this individuality in work and play.



All photographs courtesy Psychological Laboratory, Colgate University

A MECHANICAL MENTALITY TEST

Could you assemble, without difficulty, the various simple household and shop appliances illustrated here. Some women can do this better than men. The test was devised by Dr. John L. Stenquist, in charge of giving mentality tests in schools of Baltimore, Maryland



WHERE COAL IS TRANSFORMED INTO GASOLINE

View in an experiment station at Mannheim-Rheinau, Germany, in which is liquefied about a ton of coal a day. The production of gasoline from coal is now an important industry in central Europe, yielding about 25 million gallons annually

New Uses for Coal and Wood

Scientists, Seeking New Industrial Uses for Wasted Raw Materials, Produce Gasoline from Coal and Seek to Make Food from Wood Pulp

By DR. FRIEDRICH BERGIUS
Heidelberg, Germany

THE recent discovery of the hydrogenation of coal, which formed the basis of the new technical process of liquefying coal, was the outcome of research work that had been undertaken for the purpose of obtaining a better knowledge of the chemical relation between wood and coal.

Coal and wood are related in more than one respect. At first both were used to produce energy. However, during the last century and a half, wood as a fuel was pushed to the background considerably, while coal came more and more into its own. This technical development undoubtedly has been logical in an economic sense. To burn wood, that is, transform it into carbonic acid and water, means to destroy a valuable group of carbohydrates. It is significant that this group differs only slightly from those carbohydrate compounds in the human body which, by a most rational process of combustion and conversion, are used up in the processes of animal life.

But the relationship between coal and wood is not merely technical or economic. There is every evidence that wood and similar vegetable matter may be regarded as the basic substance from which coal developed. Vegetable substances, protected from the influence of air by being immersed in water or covered with soil, undergo an extremely slow chemical reaction, known as the "incoaling reaction." This process, at ordinary temperatures, takes millions of years for its completion.

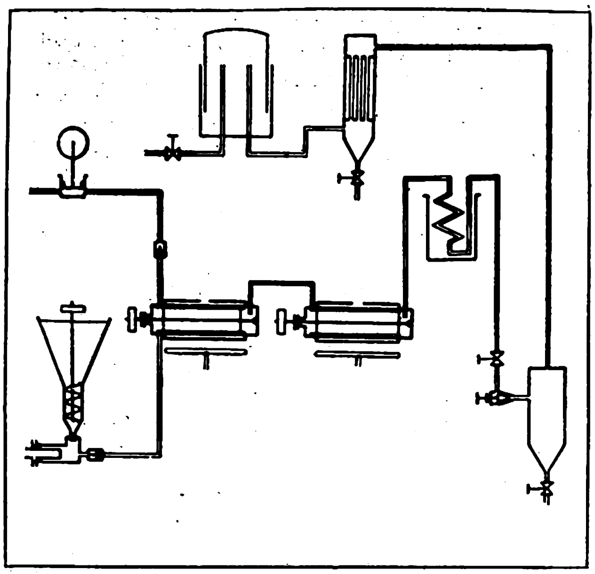
Master of Research

ONE of the greatest problems before men of science is the search for economically feasible methods of utilizing our more abundant raw materials. In this country, as well as in Europe, Dr. Friedrich Bergius is recognized as an outstanding authority on this subject. We are pleased to present Dr. Bergius' own story of his successful research.
—*The Editor.*

In the course of geological epochs, this reaction has transformed vegetable substances into what in our day is the most valuable source of energy in industry as well as for domestic purposes—coal. It is evident that knowledge of this incoaling reaction is of great importance to the chemist who wishes to gain a thorough insight into the chemical process underlying the formation of coal.

To be able to study it in his laboratory the chemist must find a method of accelerating this reaction. The usual way to speed up a chemical reaction is to subject the substance to higher temperatures. But when applying this method to the incoaling reaction, a great difficulty is encountered; this reaction, being an exothermic one, liberates a very large volume of heat. If no means are provided to lead off this heat from the reacting material, overheating occurs and the product is not coal, but a superheated coal, which has changed its chemical composition.

In 1910, working with my collaborators, I undertook to work out a method for the exact control of temperatures during this reaction, by heating vegetable matter to the required reaction temperature of about 340 degrees, Centigrade, in the presence of water in liquid form. To avoid



HYDROGENATION PLANT

This diagram shows the continuity and general arrangement of a plant designed for the liquefaction of coal

evaporation of the water we had to work under a very high pressure of about 200 atmospheres. In this way we succeeded in obtaining an exact control of the physical conditions and it became possible to study the different stages of this incoaling reaction.

The results of these experiments proved, for example, that when wood pulp (cellulose) was used as the basic material, the chief products of reaction were carbon dioxide, water, and a product which, according to its chemical characteristics, was of practically the same composition as bituminous coal, provided that the reaction was carried through for about 20 hours at a temperature of 340 degrees, Centigrade. The quantity of carbon dioxide and water formed during the reaction, as well as analysis of the final solid product, gave us an idea as to the chemical nature of this artificial coal, and it seemed likely to us that there might be a possibility of transforming this artificial coal into liquid hydrocarbons by treating it with hydrogen under very high pressure. Further experiments proved that this line of procedure was correct, and that it was possible at about 400 degrees, Centigrade, to transform artificial coal into hydrocarbons through the action of compressed hydrogen. Later we proved that natural bituminous coal could be transformed in exactly the same way.

The results of these experiments formed the basis of the first patent for the liquefaction of coal, which was applied for in 1913. We succeeded in producing about 60 percent of oil from coal, a certain percentage of which consisted of oxygen-containing compounds, especially phenols. The remaining 40 percent consisted of the inorganic material of the coal, of gaseous hydrocarbons, water, and some solid organic residue.

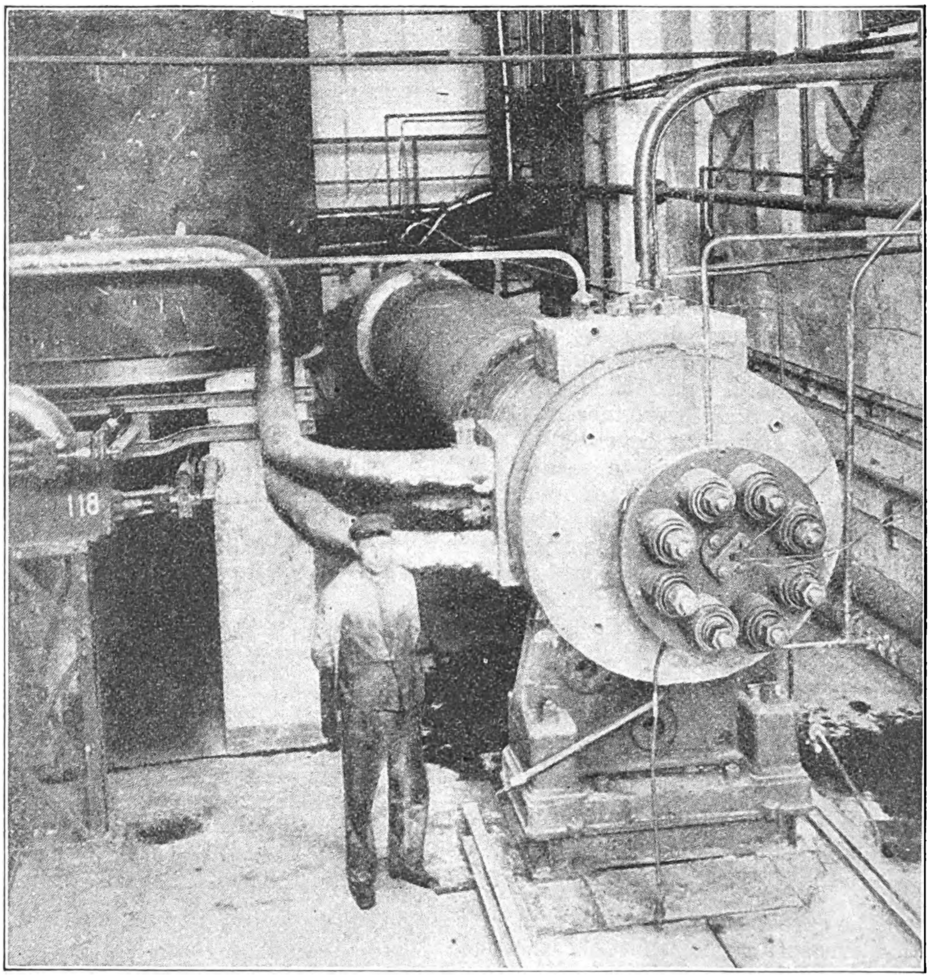
Following these first laboratory experiments, many years' continued efforts were required to perfect a commercially practical process based on this chemical reaction. Besides the chemical difficulties, the greatest obstacle to be overcome was the lack of adequate machinery, which had to be designed and constructed to withstand pressures of more than 2000 pounds per square inch.

Means had to be found for the continuous and uninterrupted supply of coal into high pressure apparatus, for the exact control of temperatures, and for the construction of high-pressure valves, stuffing boxes, and similar details of machinery. More than a decade of effort in the chemical and technical field, by a large staff of engineers and chemists, culminated in 1925 in the establishment of a process for the liquefaction of coal that has proved technically and commercially sound.

Two years ago the I. G. Farben-Industrie, the great German chemical combine, undertook to erect a commercial plant for liquefying coal on a large scale. This plant, which at present produces 70,000 tons of gasoline per year, is being enlarged to a capacity of about 250,000 tons annually. Through some new developments of this process it will be possible to transform the entire quantity of the liquid products obtained from coal into gasoline.

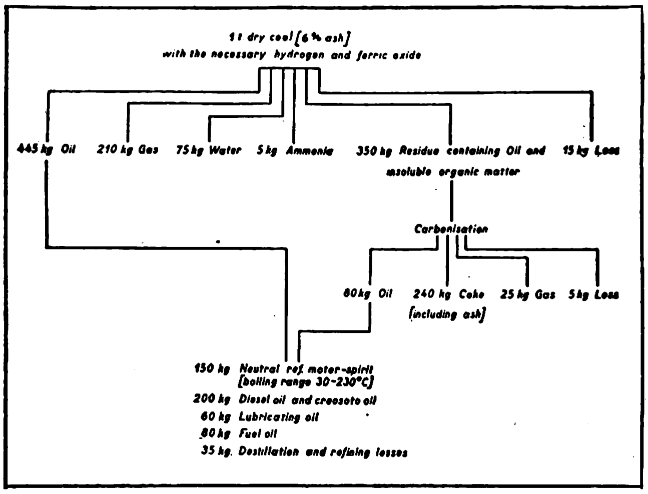
For 12 years our entire interest was focused on coal, its origin and chemical composition. This was closely bound up with our next objective, namely, research into the chemical composition of wood. In connection with the laboratory research that led to the establishment of the chemical reaction transforming vegetable substances into coal, it became apparent that, through a more conservative treatment of wood, aiming at the conservation of the valuable skeleton of carbohydrates residing in this product of Nature, new ways might possibly be found to preserve the precious natural resources of the forests which are now being recklessly wasted.

The carbohydrates are the essential part of wood and of many other agricultural waste products containing cellulose.



A LARGE COMPRESSION UNIT

This high-pressure vessel, a part of the original liquefaction plant, is 24 feet long and three feet wide. Each vessel withstands pressures of more than 2000 pounds per square inch


1 t dry coal [6% ash]
with the necessary hydrogen and ferric oxide
445 kg Oil
210 kg Gas
75 kg Water
5 kg Ammonia
350 kg Residue containing Oil and insoluble organic matter
15 kg Loss
Carbonisation
80 kg Oil
240 kg Coke [including ash]
25 kg Gas
5 kg Loss
150 kg Neutral ref. motor-spirit [boiling range 30-230°C]
200 kg Diesel oil and creosote oil
60 kg Lubricating oil
80 kg Fuel oil
35 kg. Destillation and refining losses

FROM A TON OF COAL

Yields from one ton of bituminous gas-coal by the Bergius process of liquefaction, showing the numerous by-products

They are also one of the essentials of nutrition, directly or indirectly, for both human beings and animals. They represent a concentrated product of the sun's energy and in the process of metabolism serve as fuel to produce the various kinds of energy which sustain life. In plants, Nature provides carbohydrates under various forms, rendering them a useful aid to digestion with nearly all animals, while there are those also which are only fit for use by a myriad of so-called lower organisms, such as microbes.

Carbohydrates differ only very slightly amongst themselves as regards their elementary composition, but these small differences divide them into two classes, according to their commercial value.

THROUGH the gradual evolution of agriculture in the course of the ages, some plants have been developed which contain carbohydrates in forms making them available for use as food for man and for cattle. There are other carbohydrates produced by Nature and occurring in larger quantities, which, however, are less readily digestible in the stomachs of man and beast. Outstanding among these is cellulose, which forms a very large percentage of the waste products of agriculture, and chiefly of wood.

Enormous quantities of such waste products are available in the United States, especially in the form of corn stalks. In the timber industry, at least 40 percent of the wood is discarded as waste, being put to no use at all, or, in rare instances, serving as fuel. But, as already pointed out, to burn wood means to destroy the valuable chemical inner structure of cellulose.

The prevailing enormous demand for newsprint jeopardizes the wood supply of the future. If a contingency should arise to turn the waste of the forests into human or cattle food, it would undoubtedly have a vast influence in shaping agricultural and forestry policies throughout large areas.

From these considerations we come to another problem. Can chemistry succeed in so altering the cellulose molecule that it may be made to assume a form rendering it just as digestible in the stomach as are starches and certain sugars? It has been known for more than a century that this can be done in a small way through a simple chemical reaction, namely, by adding one molecule of water to one molecule of cellulose. There is the difficulty, however, that the old established chemical reactions, although carried on easily enough in the laboratory, present enormous obstacles when put to the test on a commercial scale.

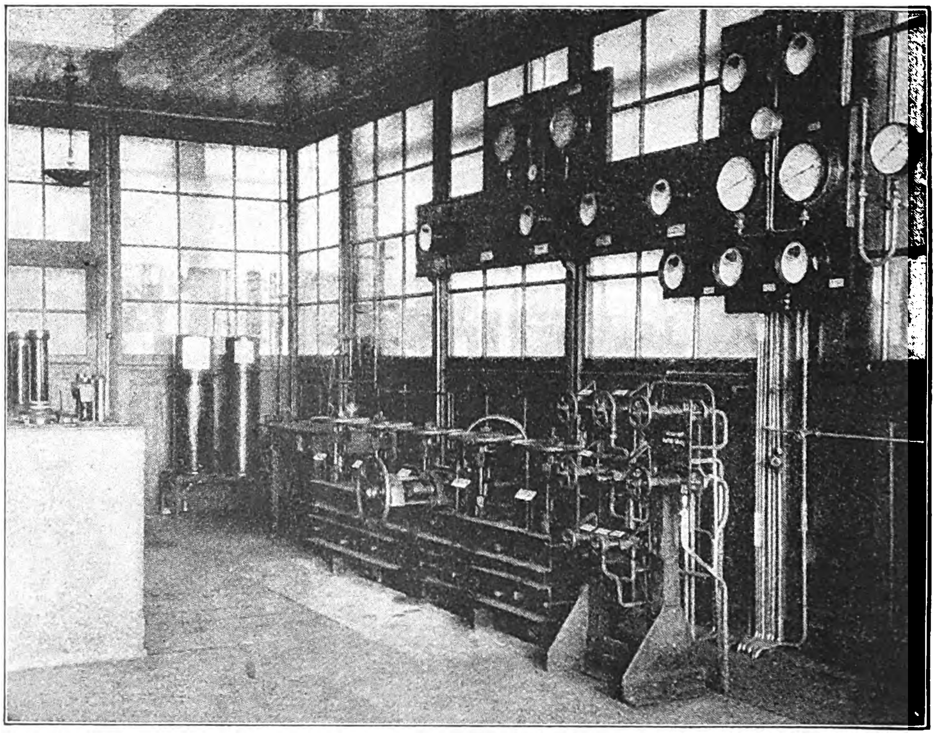
A number of processes that have been evolved in the course of time establish chemically the reaction of cellulose hydrolysis, the first practical application thereof having been made in the United States, near Chicago, many years ago. The aim of all these processes has been to transform cellulose into a product that could be subjected to fermentation, to be used in the manufacture of alcohol. Up to now all these methods have failed economically, as the yields of fermentable material have been far too low.

While the production of alcohol has been the ultimate goal of all these processes of hydrolysis of cellulose at high temperature, a new technical method has been developed in Germany in the course of the last 12 years, having for its aim the transformation of cellulose into a foodstuff.

Willstaetter, in 1913, found that through the action of hyperconcentrated hydrochloric acid, transformation into soluble carbohydrates, and eventually into glucose, could be brought about. With these laboratory results as a basis, a technical process has been evolved through which 100 parts of dry wood of any kind can be made to yield 75 percent of a crude foodstuff containing 80 percent of pure carbohydrates. This product proved to be of high nutritive value and equal to any other foodstuff of starchy consistency, and is particularly adapted for hog raising.

IN my country—Germany—where not sufficient agricultural carbohydrates are produced for cattle food, but where there is a rather large supply of wood waste, this new industry may become an important economic factor. It may also prove to be of use in America, since the problem, for example, of disposing of the corn waste in the fields, is assuming serious proportions because of the increasingly destructive activity of the corn borer.

However, the technical problems of each country need to be studied separately, and only perseverance, faith, and a great deal of optimism, not to mention time, are necessary to develop a successful industry of this kind.



VIEW OF CENTRAL CONTROL ROOM

Controls to insure the uninterrupted supply of coal into high pressure apparatus, and instruments for the exact regulation of temperatures and pressures involved in the process

OUR POINT OF VIEW

Half Truths

THE United States expects to find distorted discussions of our navy's strength, its purposes, and its "anti-British" policy in the English dailies; they generally pander to the masses. But when British periodicals in high standing publish articles comparing navies of the world and make, not one but many, erroneous statements regarding the United States Navy, it is to be wondered whether their errors crept in unwittingly or were included by design.

One reputable technical magazine, published in London, recently stated that we are to build four destroyer flotilla leaders "in the near future." Another of the same high character said that we have "projected" nine of these valuable ships. It is difficult to understand how they arrived at these figures since the records are clear for all who desire to see them. We have neither projected nor are we to build any flotilla leaders soon and it is doubtful if we build any even in the far distant future. Cruisers are far more desirable at this time and it is difficult enough to get appropriations even for cruisers. Twelve flotilla leaders were authorized in 1916, are not built yet, and there seems slight prospect of our getting an appropriation for them for many years to come.

The first magazine made a sweeping statement which let it be understood that the angle of elevation of the guns in the main batteries on 11 of our battle-ships had been increased to 30 degrees, whereas this change of the main battery guns could be made on only two. The second magazine stated that we have 309 destroyers although the records show only 262 under the effective age of 16 years and eight over that age. Both magazines made several other mis-statements which we shall not take space to detail here.

The point is that, while misleading statements and half-truths will surely continue to come from both sides, it is to be expected that reputable publications be sure of their facts and shun anything that savors of propaganda. Those people in America who favor our present naval program are not afraid of facts whether inimical to their cause or not; but they do want fair play. If British publications wish to discuss the United States Navy, they may express as many and diverse opinions as to them seems fitting; their facts, however, should be obtained from authorities, should be carefully verified, and as carefully proof-read when in cold type.

The Alloy Age Looms Up

THAT an Alloy Age would come, following the Ages of Stone, Copper, Bronze, and Iron, has been a logical prediction for some time, but possibly no single event has so strongly threatened to tip the world of industry in its direction as the discovery of the new cobalt-carbon-tungsten alloy Carboloy, described in our March issue.

A cutting edge is a commonplace thing—too commonplace, perhaps, to be appreciated by most of us. Yet it is literally man's most valuable material asset. If one inclines to doubt this broad claim let him imagine a world suddenly robbed of cutting edges. To make the things he requires, man would have ten fingers, those few pieces of wood which nature happened to leave in ready broken form, and stones capable of being used for crushing. A million years of cultural evolution would have been lost. In the last analysis, then, human advance above the ape stage has been almost wholly contingent on the ability to *shape things*, and this demands cutting edges harder than the things to be shaped.

How futile is the assumption occasionally made, that we have at last reached the summit of perfection in cutting edges or anything, has already been made manifest by the recent discovery. Even if the new, almost diamond-hard alloy cost as much as ten times its weight in gold it would be worth the price if it provided a cutting edge which would enable one workman to turn out two pieces of work where he turns out one today.

Human Sheep at Sea

SINCE the sinking of the *Vestris*, sea safety ideas have been advanced by the thousand. Some have been good, some indifferent, and others impossible. Few, however, have touched specifically on the human element.

Human beings in a panic, whether on land or at sea, are usually like herds of sheep; they lack organization and discipline and often nullify the efforts of those who would aid them. It has recently been remarked that ship passengers consider as a joke and a nuisance the life-boat drills which, according to rule, must be carried out regularly. There is no excuse for this attitude; in fact, it may turn out to be suicidal. The first law of nature—that of self-preservation—should excite an earnestness in the proper execution of these drills despite the seeming security of the ship.

It is difficult to prescribe in this case, but it seems that, since life-boat drills are looked upon as a joke, advantage might be taken of this fact by making a game of them. The captain could award prizes—a special dinner, special privileges, or something of the sort—to the boat load of passengers who got to their places most quickly and with the least trouble. If this proves ineffective, perhaps the captain should be empowered to confine to his cabin for the remainder of the trip any passenger who fails to respond to the boat-drill signal. The former method might be a lot of fun but the latter would certainly not be a joke.

Industrial Doctors

FIGURES compiled by the Chemistry Department of the University of Wisconsin show, according to reports, that industry is daily showing a greater appreciation of men who have been educated in the higher branches of science. Since the World War, 56 out of 109 persons who received the degree of Doctor of Philosophy in that department at Wisconsin have gone into industrial work. Previously, since 1899 when the first degree of the kind was given by the department, only eight persons had entered the ranks of industry.

This is not exactly news—but the figures are. Other institutions of learning could, if they would, show figures as startling if not more so, we are sure, for we have been aware of the situation for some time. Industries have already reflected this progressive spirit in their products. When more and still more doctors of philosophy turn their knowledge to the achievement of practical results, it is certain that we may expect a larger variety and finer class of industrial products than ever before.

Embryonic Schwabs or Fords or Edisons without university educations, however, need not feel that this ever-growing partnership between science and industry will shut off opportunity for them. It will, if anything, only serve to increase the field of industry's operations so that, in the end, more and still more persons of all ranks may share in the progress.

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association *and of* Hygeia

Cross Examination Under Anesthetics

FOR several years various movements have been promoted to study the effects of drugs on the mentality. Dr. R. E. House of Texas some years ago urged the use of scopolamin in criminology, claiming that the criminal under the influence of this drug has his will inhibited so that he would invariably answer all questions truthfully and that in this way the detection of crime would be much easier.

Not long ago a boy in Hawaii was abducted from school and killed. A Japanese boy who had been the chauffeur in the family was arrested, and steadily maintained his innocence. He was given a drug, and while under its influence confessed to the commission of the crime. When the drug had worn off he repudiated his confession. Then it was found that he had been in no way connected with the crime and the real murderer was discovered elsewhere.

British periodicals commenting on the case pointed out that persons accused of crime are first warned that everything they say may be used against them. A method which tricks the suspect and catches him off his guard is therefore contrary to justice and to procedure in English courts of law. The case occurring in Hawaii probably spells doom to all further efforts in promoting this method of obtaining confessions.

Vitamin C in Green Tea

RECENTLY Japanese tea growers have been publishing extensive advertisements to indicate that the drinking of green tea would provide the individual with a considerable amount of vitamin C, the vitamin that is found largely in orange juice and fresh vegetables. Its absence results in the appearance of scurvy or of the symptoms associated with this disease. In the preparation of green tea, the leaves are dried without fermentation. Fermentation previous to drying, results in black tea. For this reason it had been argued that sauerkraut and ensilage are devoid of vitamin C.

In order to study the matter scientifically, Drs. Mattill and Pratt of the University of Rochester, New York, undertook a series of tests on guinea-pigs in which scurvy had been produced by feeding a diet deficient in vitamin C. As a result of their investigations they report that green tea, even though it has some vitamin C, is of limited value for the prevention of scurvy. It cannot be used by children and should not be used by adults to replace natural foodstuffs which meet additional nutritive requirements.

Tea is not infrequently used as a part of the ration by explorers and military expeditions. In such cases it must be understood that tea is of service as a cheering drink, containing a certain amount of caffein, and that it is not of great importance as a nutritive substance or for its vitamin content.

Undulant Fever

THE sensation of the early part of 1929 in medical circles is the appearance of a considerable number of cases of a disease called undulant fever, which has been identified as the same condition as Malta or Mediterranean fever, and which has been shown by bacteriologic and immunologic studies to be associated with contagious abortion in cattle.

The first human case of undulant fever was described in the United States in 1903 by Col. C. F. Craig of the United States Army Medical Corps. More than 30 years ago David Bruce, the famous British investigator, identified the organism of Malta fever, and it now bears his name, since it is called *Brucella melitensis*. Later, Dr. Alice Evans of the United States Public Health Service established a definite relationship between contagious abortion in cattle and Malta fever in human beings.

Since that time it has been realized that the disease can be transmitted not only by the milk of goats, but also through contact with infected cattle, hogs, or horses. Through investigations completed by A. V. Hardy of the United States Public Health Service, cases have been found among workers in packing houses, on farms, and in small towns. Hence the problem of stamping out the disease among those handling infected stock is a pressing one.

Undulant fever is so-called because its chief symptom is a fever which comes and goes in waves, and which lasts in the mild cases about three months, but in the more serious cases as long as three years. The disease resembles typhoid fever, heart disease, or tuberculosis in the early stages and is differentiated from these conditions only by a specific test of the blood, similar to the Widal test that is used for typhoid fever.

Cases have already been reported from practically every state in the Union. The problem of prevention seems to be the control of the three "f's"—fingers, food, and flies. Workers with herds of cattle in which contagious abortion has occurred must be particularly careful about hand hygiene. Milk should be pasteurized, and screens will take care of the fly problem.

Narcosan and Drug Addiction

ALMOST two years ago the startling announcement was made that investigators in the Blackwell Island Hospital in New York had discovered a cure for drug addiction in the form of a mixture of protein substances called narcosan. At the time the *Journal of the American Medical Association* pointed out that the evidence was highly doubtful and that the record of the promoter of the new preparation was not such as to inspire confidence.

A special committee appointed by the Mayor of New York, headed by Dr. Alexander Lambert, has made available the results of an investigation carried on in the Bellevue Hospital since May, 1928, with a view to establishing definitely the actual merit of the narcosan preparation. The narcosan treatment was given to 68 patients who were carefully watched and who were compared with other patients treated by the usual general measures. The committee reports that the symptoms occurring in patients receiving narcosan were more severe than in those not receiving narcosan, and the results show clearly that narcosan has no merit as a specific treatment of drug addiction.

Hair-A-Gain Exposed

OF all the substances promoted for the delusion of mankind, none is so prolific of humor and comedy as those having to do with the human hair. In such cases men are notoriously credulous. Furthermore, since the time of Elijah, man's head despoiled of its hirsute adornment has been the subject for the jests of the comedians.

The *Journal of the American Medical Association* recently investigated "Hair-A-Gain" scalp and hair shampoo promoted by a lady in Los Angeles as a product which would enhance the beauty, sheen, luster, color, and texture of the scalp and hair. Analyses made in the laboratory of the Association indicate that this product has simply a tar or tar-like substance as a base and that it was sufficiently strong in some cases to take off the surface of the scalp.

Nevertheless it was promoted with the claim that it would restore grey hair to its natural color, as well as grow hair on bald heads. As with many other nostrums in this field, the radio has been used largely in its promotion. It should be unnecessary to tell any intelligent reader that only hair dye will give grey hair a dark appearance, and that in the majority of cases of hereditary baldness, so far as is known, there is nothing that will cause a growth of new hair.

Clothing and Man

THE eminent English physiologist, Prof. Leonard Hill, has recently considered the effects of clothes on the human body. Primitive man used clothes primarily for display, since he was little concerned with keeping himself warm or protected against the elements, unless insects are included in the latter category. Human beings vary in their ability to stand exposure. Thus channel swimmers spend 20 hours in the cold sea with only a wool bathing suit and a coat of grease; whereas a preacher who consulted Professor Hill wore a thick woolen vest, a woolen shirt, a woolen lined waistcoat, a cardigan, a tweed suit and a woolen lined motor coat. Probably even with these he still complained of the cold.

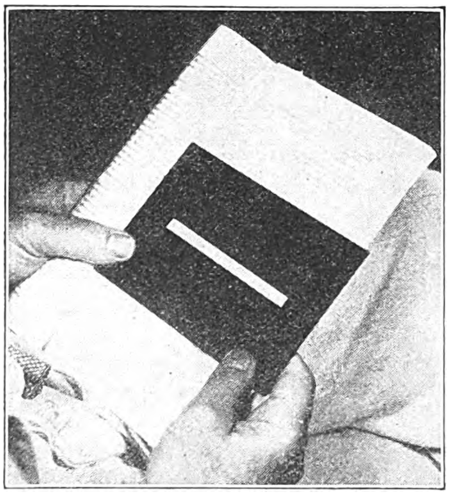
The dress of woman has changed largely in recent years and has given much concern to the physiologists. Professor Hill points out that a civilized man when naked and quiet finds exposure to still air at 95 to 98 degrees, Fahrenheit, not unbearably warm, 76 to 86 pleasant, 60 cold, and 40 to 50 very cold. For sedentary occupations he wants the atmosphere under his clothes to be 95, and only about 20 percent of the body's surface to be exposed to the air.

On the other hand, people used to being outdoors can stand much colder temperatures, and children vary in their garments from those accustomed to thin garments and bare knees to those in elementary schools in foreign districts who will wear as many as 14 different garments, some of these sewed on for the winter.

It may be taken for granted that in the majority of cases children are being overclothed, and as a result do not develop any resistance to exposure. On the other hand, insufficient clothing for the child may lead to a prompt response with numerous illnesses during infancy. Perhaps the question will never be settled until human beings have standardized clothing as they now standardize most other affairs in human life.

Diseases of the Eye in Old Age

IN a symposium on diseases of the eye in old age, Dr. W. H. Wilmer of the Johns Hopkins Hospital, Baltimore, recently considered particularly the diseases of the eye and the changes that occur in the eye with age. The whole eye tends to become smaller as people become older. The skin around the eye becomes thinner, less elastic, and folded so that the typical crow's-feet form. The muscles of the eye are likely to weaken, if not to become paralyzed with advancing age, and the delicate tissues harden, the changes interfering with vision. The iris or colored matter of the eye undergoes senile changes with the formation of little granules that appear like small particles of black pepper.



READING SLOT

This device is said to be of value to the eyes of the aged. Description is in text

There is a tendency also for the iris, which controls the size of the pupil, to become thicker and more rigid so that the pupils of the eyes of old people are smaller and less easily movable than in the young. The lens of the eye grows larger throughout life and in very advanced age thickens, while deposits form within it. From early youth on, the inner portion of the lens increases in size and hardness until in advanced age the lens is practically all nucleus and is inelastic. The senile lens is particularly subject to the development of cataract.

Becasue of these changes, the upper eyelid tends to droop in the aged, and Doctor Wilmer suggests that the lid can be raised by the fingers or supported by a device fastened on the upper rim of the spectacles. It is also possible through surgical operation to take out a portion of the lid, making it shorter.

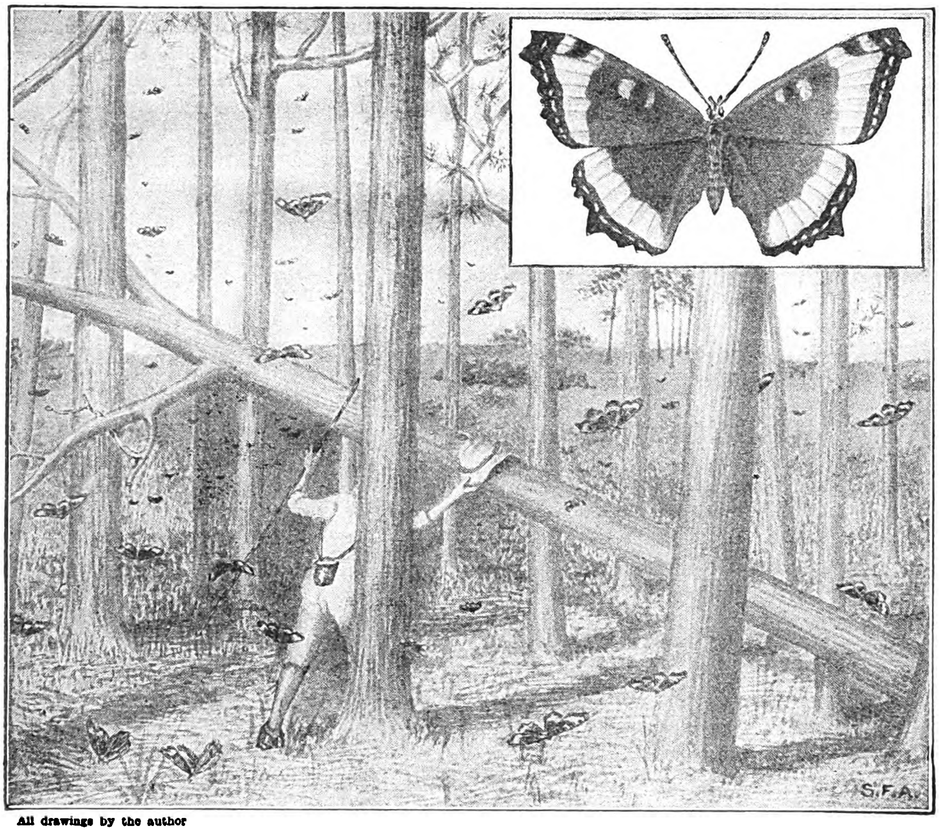
The eyes of the aged should be encouraged by the use of good light, suitable soft diet, and among other things the use of a reading device which is shown in the illustration. This device consists of a piece of black rubber six by four inches, in the center of which is a slit four inches long by one fourth of an inch wide. It is thin and light and can be easily moved down the page in reading, the aperture making clear all the print within its space.

This device lessens pupillary contraction, which is caused by a large white reflecting surface, gets rid of blurred secondary images and reduces irregular astigmatism, and spherical aberration. Like the mydriatic, this device sometimes makes reading possible for persons too ill or infirm for an operation, or renders an operation unnecessary. In other cases, it enables one to read until the cataract can be extracted. Nearsighted persons can use the slit without glasses; the far-sighted persons can use their regular reading glasses in addition. The ordinary hand magnifying glass or the newer telescopic lenses may give added help.

Japanese Decoration for Scientific Investigations

IN the history of the progress of medical science, the Japanese hold a high place, due not only to the work of Hideyo Noguchi, martyr to discoveries in the field of yellow fever, but also to many other contributors who have done fundamental work in the field of bacteriology and of physiology. Recently the Japanese government developed a new decoration called in English "order of merit in culture" but in Japanese "*Bunko-Sho.*" This is conferred on all who distinguish themselves in literary work or art, or who achieve merit in connection with the progress of human culture and social welfare.

It is a significant fact that this decoration was conferred during the coronation of the emperor in November for the first time, and the two men on whom it was conferred were men who have done noteworthy work in the field of medicine. These were Doctor Shiga, co-discoverer with Simon Flexner of the bacillus responsible for causing infectious dysentery, and on Doctor Inada, who is credited with being the discoverer of the *spirochaeta icterohemorrhagica*, the organism associated with tremendous epidemics of infectious jaundice.



All drawings by the author

AN AUTUMN FLOCK MIGRATION IN NEW JERSEY

Witnessed among the pines of southern New Jersey in November, by the author who knocked a specimen down with his hat. It was Milbert's butterfly, *Vanessa milberti*

Why Do Insects Migrate?

More Controversy Than Knowledge Surrounds Their Mysterious Flights From North to South and Return

By S. F. AARON

THE migration of birds to meet the changing conditions of the seasons has given investigators about all that is known concerning the extension of flights, directions, topographic influences, and possible causes of those still somewhat mysterious winged journeys from clime to clime. There has been much controversy about the initial impulses that set birds in migration, and much remains to be learned regarding the routes and the winter resorts of many species.

The short and infrequent migrations of mammals result entirely from overcrowding, and this may also be said of certain reptiles. The ready trading of semi-tropical and tropical regions for those of the temperate zone, and vice versa, is very decidedly a job that may be undertaken only by wings, at least in coastal or level countries. Certain quadrupeds in high mountain sections, however, do make seasonal changes in altitude over short distances, mainly a matter of altitude.

So little attention has been given the subject of migration among insects that the investigator must rely, so far, almost entirely on his own observations. There are some data, but for the most part they appear to be woefully unsatisfactory, seeming to depend largely upon supposition, and may even be included in the class of nature faking—which term ought to be taboo among naturalists.

SIMPLY because certain species of insects have been seen congregating, later to disappear; and because large numbers of the same forms make their appearance still later in distant sections—is not sure proof of long migratory flights, although, of course, it is indicative.

The best evidence thus far obtainable concerning insect migrations is that of great numbers of a species making a southern flight in the autumn, and a corresponding northern flight in the spring, although this alone cannot determine the precise extent of these journeys. There seems to be lacking, also, information as to the district commonly visited for winter quarters.

In the Indian summer days of one early November, while in the forest not many miles inland from the southern New Jersey coast, I suddenly became aware of a vast number of medium-sized bright red butterflies around me, all of them flying in one general direction, pursuing a southwesterly course which at that point paralleled a distant inlet. For perhaps ten or fifteen minutes this flight continued, at the end of which the insects rapidly diminished in numbers. Not one of the little creatures paused or alighted for an instant, but I was enabled to strike one down with my hat and was astonished to find that the species was Milbert's anglewing, *Vanessa milberti*, the most southern summertime and breeding habitat of which in the lowlands is the New England States, although the species is found along the higher Alleghenies as far south as North Carolina.

I BELIEVE there is no previous record of this species ever having been taken within 200 miles of southern New Jersey during the warmer periods of the year. Where were these beautiful, swift little creatures going? I needed wings to find out, for theirs is the speed of a running horse. Was this flight only exceptional—a chance occasion? The only thing that could check the onward rush of these daring, fragile butterflies would be a lowered temperature, and that very thing occurred the following day; but even so they must have benefited, judging by the wintering habits of other and allied species.

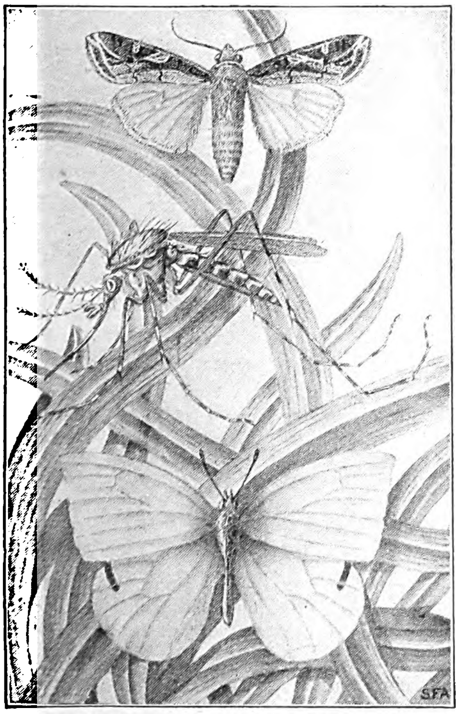
On a late October day, within a mile of the eastern stretch of the Mason and Dixon line, I saw another medium-sized butterfly, *Vanessa j-album*, a species taken only by northern collectors and rarely found in the warmer seasons south of the Pennsylvania-New York line and southern New England, its breeding range being similar to that of its close relative, the *milberti*. This individual that had wandered so far south of its common habitat was well worn by travel, although exceedingly active; it would not have graced the cabinet of a collector, and judging by the way it dashed about the eaves of an old cabin, it evidently had no such intentions.

Eager to obtain the specimen for a locality label, and not having a net with me, I struck at the creature with my hat, but very naturally missed it and away it went, straight up the road toward the adjoining farm, as though it had previously investigated this section. There it hovered for a time about the barn and shortly disappeared, finding, I sincerely hope, a safe niche for the winter.

While cutting chunks for the fireplace from a fallen chestnut tree during January, in Delaware County, Pennsylvania, my axe split open a limb that had accommodated many large Cerambicid borers, the fat larvae of those gray, black, and brown beetles called longicorns. These borings had also been formerly occupied and widened by black ants, and later deserted. Almost having wedged itself into one of these, its wings crumpled by the effort, was a specimen of this *j-album* butterfly stowed snugly away for the winter and entirely inactive, for the weather was very cold. The insect soon revived when brought indoors. Again I may say that I believe there is no previous record of this insect being taken during the breeding season within 50 miles or more of the localities above mentioned.

A QUESTION was raised by these experiences that chiefly rests upon conjecture. If these butterflies journey to slightly milder climes for hibernation, what do they gain by it? There is not a very great difference in actual degrees of temperature—perhaps at best a matter of 15 degrees in the extreme. And it has long been ascertained that insects of temperate regions, when still vitally active, their natural functions not having been impaired, can survive almost any degree of cold.

It also is worth noting that following severe winters the insect life is generally more abundant than when an open mild winter has given the numerous enemies greater opportunity to pry into hiding places and shelters. Again, it is found that frequent thawings and freezings are much more likely to be fatal to all insect life than continuous cold. Why, then, the long journeys of a hundred miles or more to find conditions that are not more favorable?



NOTABLE INSECT MIGRANTS
Fall army worm moth (top); common salt marsh mosquito; *Kricogonia* butterfly

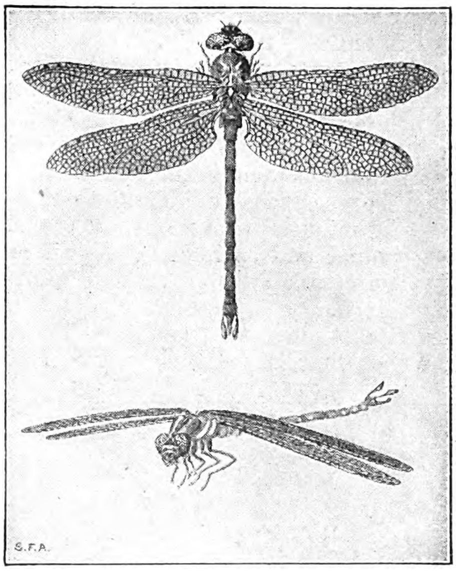
As a young collector in eastern Tennessee I not only became familiar with the butterfly fauna in general, but I knew also the local habitats of most species. On rare occasions we took specimens that were distinctly northern in their range, although these may have come down to us from the higher ridges of the Big Smoky Mountains, possibly by mere chance, just as some southern forms ranged up from the Gulf coast. It did seem odd, however, that nearly always the former were taken in the autumn, as though the insects had sought a close-by warm section in which to hibernate. Two of these were the anglewings, *Grapta faunus* and *G. gracilis;* another was the wood nymph *Satyrus alope* variety *nephele,* which latter rarely, if ever, has been known to hibernate, although it occurs late enough in the season to make use of the habit.

It would seem almost like sacrilege to dwell upon this subject at all without mentioning the great monarch butterfly, the gregarious habit of which is too well known to need description.

IT has been asserted that this insect travels by wing hundreds of miles, even reaching sections where it cannot multiply because of the absence of its food plant, the milkweed. The wing power of the species is well known and clouds of the insects have been seen far out at sea, but I think it doubtful that its inhabiting of far countries has depended upon its flight; nor am I ready to believe that its migrations in our own country are proved to be very extensive.

In southern Delaware I witnessed the arrival of a swarm of these butterflies about or soon after the time that they were commonly swarming in sections a hundred miles or so north of the spot. They came on like a great swirling cloud, settled upon everything and gradually dispersed. My note-book records the date as October 14th, a little after 11 A.M., a mild, sunshiny day. For an hour or more the air was full of red wings going in every direction, but time prevented tracing any individuals to their roosting places, as the day approached its end. A visit to the locality the following day showed an abundance of the butterflies with no apparent attempt to swarm again, and it is very doubtful if they did so.

From the conditions of the specimens captured and observed closely it was evident that they had not flown far. But why should they? Nature generally works along in the course of least resistance, and although swarms of the monarch have been seen at sea, they were the victims of contrary winds.

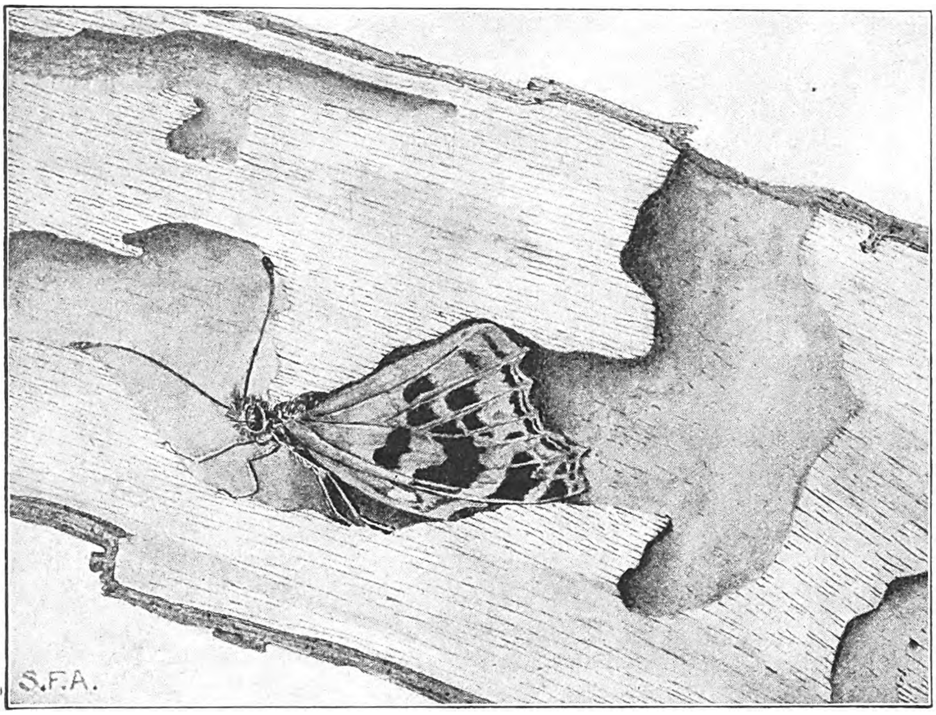


THE AIRPLANE INSECT
An *Aeschna* dragon fly. These most graceful winged hexipods are regular migrants

That there is a tendency on the part of some insects to journey for the winter into localities that are sunnier and warmer there can be little question. This, to my knowledge, applies to one butterfly and two dragonflies. It may safely be asserted that the habit of migration is exceptional among insects; almost all species either hibernate in the adult form, where they breed, and these are in the minority, or they die, depending for the continuation of the species upon the sheltered, immatured stages which can always resist cold.

IN the lower counties of Texas, throughout the pastured areas and those of the cactus and ever-flowering lantana, the chief representative of the sub-family *Pierinae,* with the exception of the sulfurs, may be known only by its scientific name, *Kricogonia lyside.* It is a medium-sized, buff-white butterfly with very few markings and swift on the wing. During the heated period of the spring rainy season and the summer droughts this insect is by no means common throughout the area along the Rio Grande, although I confess I do not know where it is found at that time in numbers. At or near the end of the dry season, along in September or a little later, the prairies from the Guadalupe River valley southward teem with countless numbers of these butterflies, all flying directly from the north and toward the south, many of them going far into Mexico. After this time, throughout the area mentioned, the species is very common. In April or early May another flight takes place, although in vastly reduced numbers and the direction is entirely northerly. Where they go, however, is yet to be determined.

I had the delightful experience of witnessing these migrations of *Kricogonia*. That of the fall period could not but draw exclamations of wonder even from persons indifferent to creatures of minute proportions. Close to the ground and as high in the air as the eye could detect such pale glinting things, the butterflies passed on, never stopping to visit the many honeyed flowers on their way. But upon reaching the region within 100 miles of the lower Rio Grande, there was probably a quick dispersal, for, traveling through that section a little later, we found them in large numbers going about their business of seeking sweets, commonly from the freshly dampened earth.



A NORTHERN BUTTERFLY HIBERNATING FARTHER SOUTH

The retreat depicted in the author's drawing is a beetle larva boring in a dead tree limb. The butterfly is probably about two hundred miles south of its regular summer habitat

NOT the least interesting among winged insects capable of prolonged flight are the dragonflies, especially those larger and more powerful forms that are built remarkably close to the lines of a modern airplane, lacking, of course, the same kind of motor. These are, in fact, typical biplanes of the pursuit type, the forward wings being above and considerably ahead of the lower pair, with all four working independently of each other, although generally in unison.

Dragonflies are not, despite fanciful statements to the contrary, the swiftest of insects, but they are surely the easiest and most graceful on the wing and capable of the most sustained flight, being constructed in this respect with incomparable regard to relative muscle and wing expanse. That these masters of the air should have formed, through long inherited inclinations, the habit of keeping ahead of inclement weather is no more surprising than that the swallows should do the same. Insects and other cold-blooded creatures are far more susceptible to slight changes of temperature than those of warm blood, and it may be observed, although with some difficulty, that these tireless, swift-winged, diurnal species which nearly emulate the nocturnal bats, often tend in their wanderings to progress toward the sun as it lowers toward the winter solstice. Thus I have seen, during a day afield in October, many hundreds of these largest dragonflies, known as *Aeschna*, and particularly the common species *furcilata*, all flying southward and pursuing nearly the same course in general, on the way taking many unwary insects in the air. A little earlier, until late September throughout southern Pennsylvania, these insects are still skimming about. It may be observed also that some of these large *Odonata* remain in colder climes, attempting to hibernate in dense bunches of leaves, although it is doubtful if many survive, because of the diligent winter birds.

I witnessed one extensive migration of *Aeschna furcilata* in the prairie country. These insects are never noticeably gregarious, and that so many were performing the journey at the same time was due entirely to a common impulse, no doubt influenced entirely by the changing temperature. We were traveling by wagon team due west; we found the big dragonflies heading straight south, continually coming on to the right, going on our left, never high in the air, never mixing nor flying close together, but in any direction our eyes could take in hundreds. As with the *Kricogonia* butterfly, there were countless millions, but unlike the butterfly the migration continued not only during the hours of brighter daylight, but toward dusk.

I have suspected some other dragonflies of the migratory habit, a species of *Cordulia* and the great *Tramea basalis*. Other winged insects show the migratory instinct—not confusing this with the swarming nor with the marriage flights of several species. Some are not at all understood: for example, the late summer swarming of the mosquito *Culex iritans*, northerly along the coast, out to sea or in any direction. This may be a hereditary instinct not well developed.

QUITE different is that of the well-known salt marsh mosquito, *Aëdes sollicitans*, by far the most plentiful of all *Culicidae*. This insect breeds only in brackish water, yet countless numbers of them from Canada to Central America regularly migrate inland many miles in order to obtain food, and almost as regularly return to deposit their eggs. These flights are commonly distributed; sometimes, however, the insects are *en masse*, forming vast clouds that have given rise to the statement that they darken the sun. This is rather an exaggeration, as the flights generally occur at night, although the insects are active at all times.

Many of the experts have given the greatest distance of these flights as 25 miles, observed in New Jersey and the Florida everglades. In southern Texas the writer has taken specimens more than 70 miles inland from the coastal salt water and at least 50 miles from the nearest brackish water, although the mosquitos were not plentiful.

Another common insect migrant is the moth of the well-known and pestiferous fall army worm, *Laphymga frugiperda*, a southern species with an apparent tendency to journey north, these flights being inspired by the desire to find abundant and fresh food plants. Often several hundred miles are thus covered by these strong-winged noctuids, flying in large numbers at night and with the same objective, as shown by the vast number of eggs being laid over a relatively small area and the consequent injury by the resulting caterpillars. From time to time the bright lights in our city streets have interfered with and checked these migrations, to the discomfort of pedestrians, but in many cases no doubt resulting in the destruction of thousands of moths and a consequent very material lessening of the worms in the fields beyond.

Safety for Those Who Go Down to the Sea in Ships

AWARDED BY
THE AMERICAN MUSEUM
OF SAFETY

THE winter just past has, without doubt, been one of the worst in many years in the age-old story of the sea. The Atlantic has been particularly boisterous, has claimed several ships and many lives. It has been the scene of disaster and peril, of despair and heroism, of losing fights and triumphs over its relentless fury.

Following the focusing of public attention on the problems of the sea by the loss of over a hundred lives when the *Vestris* foundered, other ships sank or passed through periods of great danger. Even on the luxurious *Majestic,* a life was lost and the great ship itself was damaged when a mountainous wave swept over it. The climax of the winter's series of battles with the sea came with the news of the rescue of the entire crew of the Italian freighter *Florida* by courageous Captain Fried and his crew on the steamer *America.* Nothing can detract from the glory of this thrilling rescue on the storm-tossed high seas; the brave attempt was successful not because of efficient equipment but principally because of the fact that the rescuers were iron-nerved and fearless.

In view of these facts, shipping interests throughout the world are acclaiming the efforts of those who are studying the problem of safety at sea. Thus, SCIENTIFIC AMERICAN'S announcement of a gold medal to be given in 1929 for sea safety devices or equipment has aroused the interest of thousands and already a number have signified their intention of participating in the competition. All the details of this competition have now been worked out and the committee of judges is complete.

THE conditions of the SCIENTIFIC AMERICAN Gold Medal for 1929, to be awarded by the American Museum of Safety, supplementary to, and amending the announcement in the February and March, 1929, issues of SCIENTIFIC AMERICAN, are as follows:

(a) The devices, apparatus, designs, or constructions submitted must have been developed or improved upon since the last International Conference for Safety of Life at Sea (1913).

(b) They must be self-contained on the ship, or an integral part of the ship.

(c) The Committee will give special consideration to the practicability and economic application and operation of the devices, apparatus, et cetera.

(d) An important factor of any device, design, et cetera, would be the practicability and feasibility thereof—the decision as to both to rest entirely with Committee.

(e) Preferential consideration will be accorded to apparatus available for simple manual operation, in addition to any power operation of above; or aided by such resources as would be available on board at all times; such as electrical apparatus operated by current from storage batteries also.

(f) All applications must reach the office of the American Museum of Safety, 141 East 29th Street, New York City, by September 30, 1929. No models should be sent unless requested by the Committee.

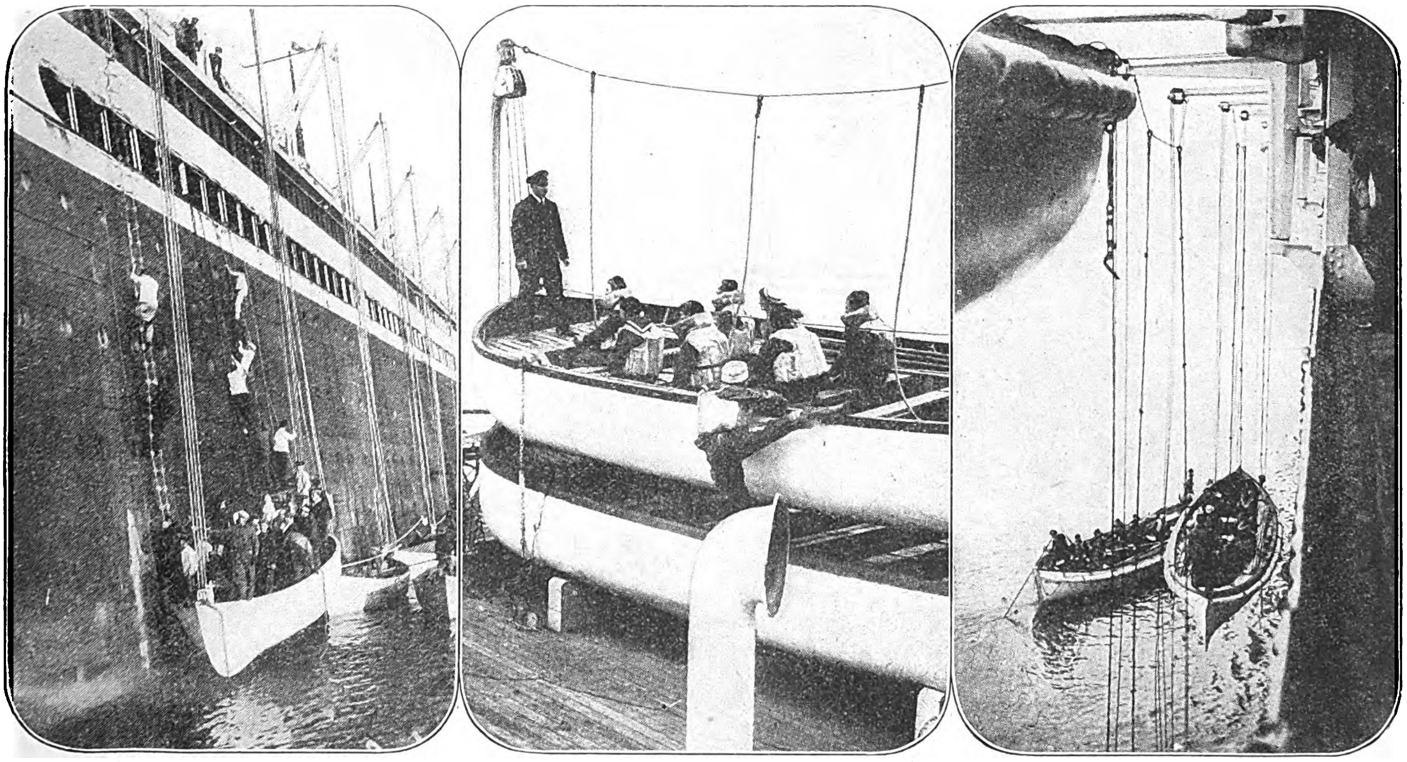
The committee consists of the following:

Chairman
  Rear-Admiral C. McR. Winslow

Vice-Chairman
  Capt. E. T. Fitzgerald

  Rear-Admiral W. S. Benson
  H. H. Brown
  Captain T. H. Lyon
  Captain C. A. McAllister
  Captain H. McConkey
  A. B. Newell
  Rear-Admiral C. P. Plunkett
  Captain F. Riesenberg
  L. Weickum

Ex-Officio
  A. A. Hopkins, Director
  J. F. Parker, Secretary

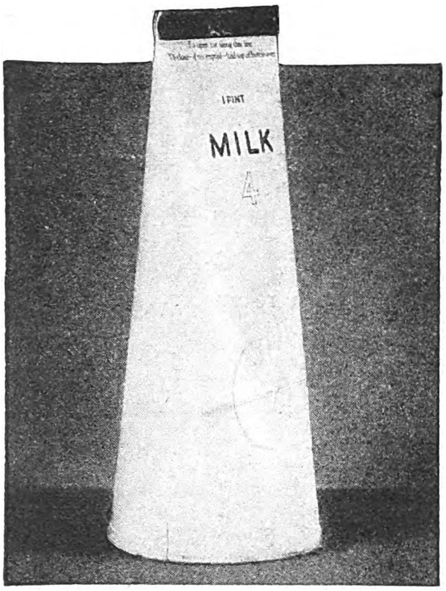


FOR GREATER SAFETY AT SEA

It is vitally important that life boat drills be practiced regularly on all ships but the crews of larger passenger-carrying steamers should be letter-perfect in these drills. At the left is shown the *S. S. America,* and center and right the *Leviathan,* carrying out life-boat drills

Paper Milk "Bottles"

An Improvement in Milk Distribution Which May Revolutionize a Vast Industry



THE PAPER "BOTTLE"

The milk bottle and the milk wagon are endangered by this new paper container

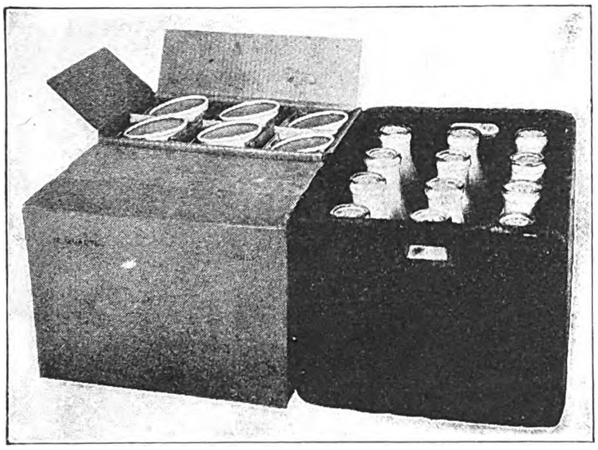
A NUMBER of years ago the SCIENTIFIC AMERICAN made a broad canvass of representative sanitarians, heads of boards of health, et cetera, relative to the hygienic position of the glass milk bottle, but at that time very little progress had been made on a paper container, and things ran along as usual and the big milk companies had to put in larger and larger bottle washing machines and the bottle making firms added more furnaces. Now, however, after a long period of incubation the paper milk bottle emerges from obscurity and bids fair to put both the glass milk bottle and the time-honored milk wagon itself out of business.

The combined dairy industry produces food products of prime necessity with a total annual value of five billion dollars—greater than the entire output of the motor car industry—greater than the entire output of the steel industry—greater than the combined annual value of the cotton, wheat, and potato crops.

During the last 40 years, progressive milk distributors, aided by the medical fraternity and sanitary authorities, have made vast capital investments to improve methods and have built and equipped the best possible plants to handle milk under the most ideal conditions money, skill, and science could provide. Dairy inspection, milk inspection, pasteurization, grading, certification, glass lined tanks, refrigerator tank cars, all have been adopted at great expense to protect the purity of milk and make its safety equal its importance as a food. Despite all this effort, little progress has been made until now in the actual packing and delivery of milk to the consumer.

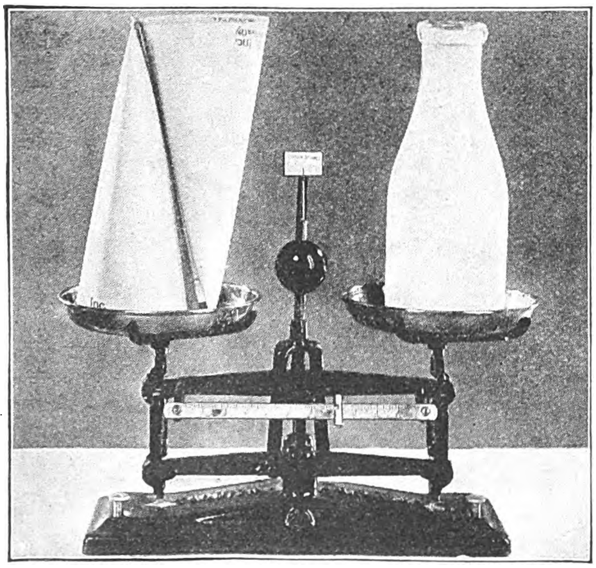
THE introduction of the glass bottle 40 years ago was a long step forward from those days when the milkman filled from an open can the pitcher or pail left at night on the doorstep, but the glass bottle with easily removable paper cap admittedly has proved unsatisfactory and has never rounded out the perfect milk service.

One of the largest dairy concerns operating in New York has already installed facilities for making 50,000 quart paper containers a day, as the installation of the first unit. The new container has been received with considerable applause by the newspapers and the consumers and wide publicity has been given to the advent of the "Sealcone" as it is called. The new container is cone-shaped and is made out of spruce fiber which is subse-



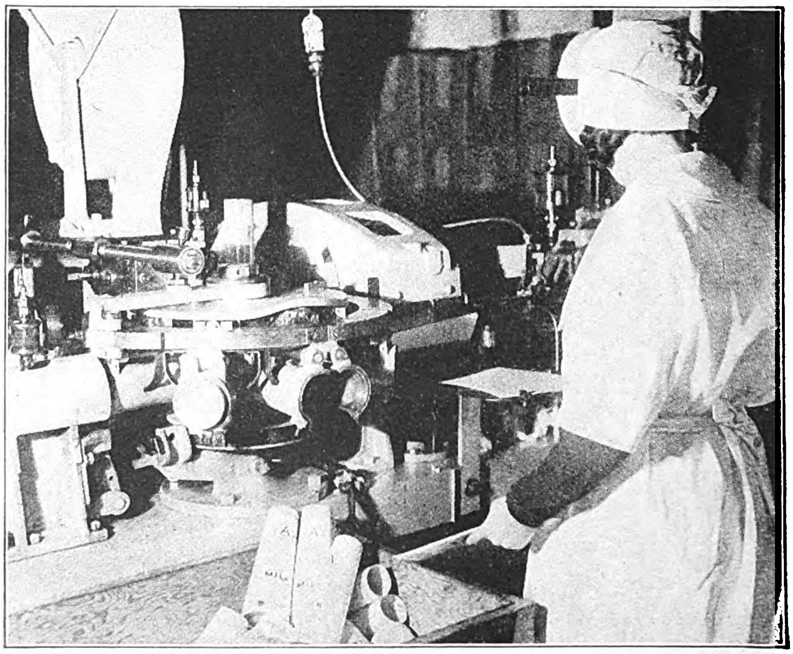
THE NEW SPACE SAVER

To the left are Sealcone cartons, holding 24 quarts of milk. To the right is a case with only 12 glass bottles



TWICE AS MUCH MILK

Weight is a great factor in milk delivery. On this scale are two quarts of milk in the new sealed containers in the left hand scale pan, while on the right is a filled glass quart milk bottle. Two of the new containers filled with milk weigh only seven ounces more than the quart in glass—68 ounces as compared with 60.4 ounces. The saving in transportation is apparent



FORMING THE CONES

This machine makes the cone-shaped tubes from blanks and fits in a circular disk which is tightly "spun" in to make a solid impermeable bottom quently paraffined. It is light in weight (one and one half ounces) and is leakproof and airtight. It is as durable as is required, for it is thrown away after the milk is used. It is sealed very positively and cannot be tampered with. The date of pasteurization is stamped on the seal.

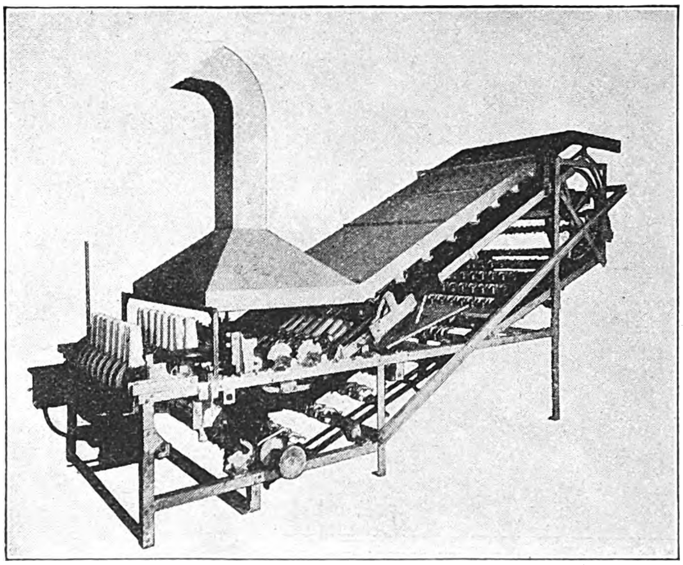
The new container brings to the consumer fresh sweet milk in a completely sterile condition. It has been found that this paper cone keeps milk sweet longer than any other kind of container. The Sealcones eliminate all washing of bottles—always an expensive operation. It also does away with freight on bottles from the factory to the bottling plant and the picking up of "empties" by the milkman. Glass bottles are fairly expensive and, in the case of stores, a deposit is usually exacted from the customers.

The paper containers can be filled with milk at a temperature of 33 to 35 degrees, Fahrenheit. This is far below the point at which bacteria begin to flourish (40 to 45 degrees, Fahrenheit) so that the milk is sealed in a sterile condition. Milk in Sealcones has been kept, of course under proper conditions, for long periods. Dr. L. I. Harris, former Commissioner of Health of New York City, says that the growth of bacteria would be slower in the cardboard than in the glass. He also hopes that the milk companies will reduce the cost of its product to the public so that containers will be within the financial reach of those who now use loose milk. Of course, the companies must have time to write off the old washing machines before any tangible reduction could be expected.

The new container can be opened quite simply by cutting off the narrow end of the cone—a scissors will do. Compare this to pushing in a milk bottle cap. Instructions are printed on each container.

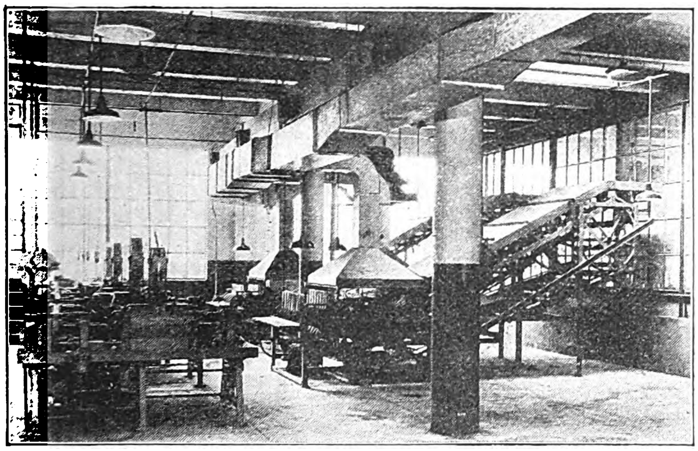
If the glass bottle goes, it is quite likely that the old milk wagon will disappear for the company which has supplied the container is also manufacturing a carrier built on a motorcycle side-car chassis which carries 360 quarts of milk, 60 quarts more than the average glass load.

Our illustrations with their captions fully describe the various processes. The paper is die-cut to the proper size. The machinery comprises one continuous process and the equipment is divided into three units, all of which are shown. They are: the forming machine, the paraffining machine and the filling and sealing machine. Such, in brief, is a solution of the problem of modern milk sanitation and efficient distribution.



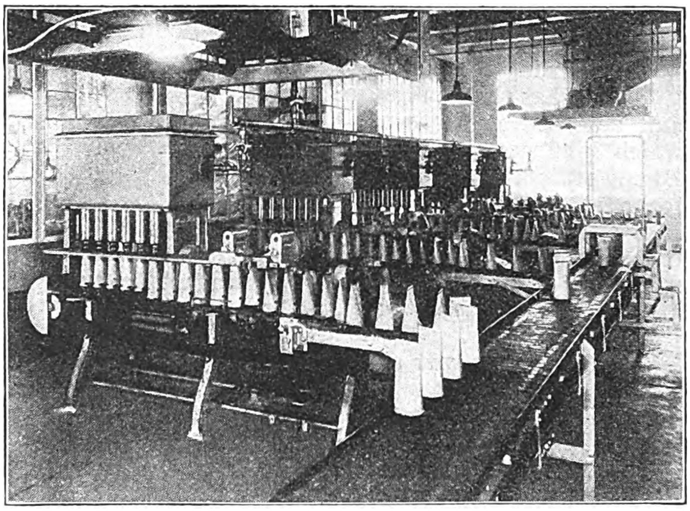
STERILIZING

The new milk container is sterilized, after fabrication, by running through a bath of hot paraffine, and it is then chilled by washed cold air. The Sealcones emerge leakproof and sterile ready for the fresh milk



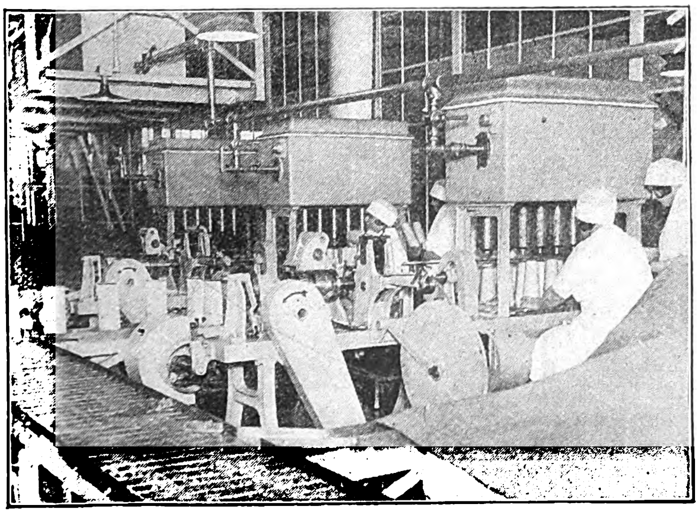
MAKING

Here is seen an actual installation, in New York City, of the machinery for making and sterilizing Sealcones. The equipment illustrated has a capacity of fifty thousand new containers in eight hours



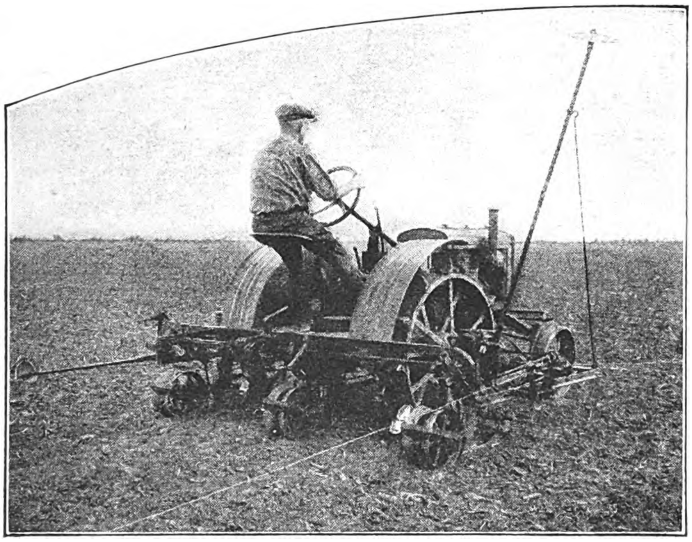
FILLING

Here the newly manufactured Sealcones are filled with milk, sealed, and stamped with the date. All these operations are performed automatically and hygienically. The seal is airtight and cannot be used over again



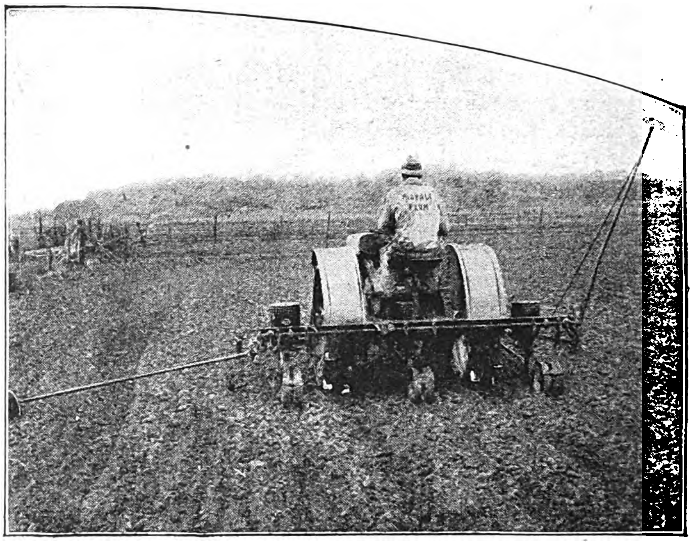
SEALING

The rust-proof metal seal prevents tampering with the contents. The seal itself does not come in contact with the milk. The date of pasteurization is automatically stamped on the metal seal of the container



THREE-ROW CORN PLANTER

This labor-saving machine plants at a uniform depth. By means of differential brakes it can be turned around squarely at the end of the row, this feature making it useful on small fields



30 TO 40 ACRES A DAY

View of another three-row corn planter with which one man can plant in one day several times as many acres as a man with a team of horses. Seed containers may be seen before the following wheels

Making the Farm Pay

A Practical Farmer Gives, From His Experience, Some Rules For Running a Farm Scientifically

By FRANK M. BYERS

IN industry there are certain economic laws which govern profit. Accounting records on farms also, show that there are economic laws and accepted methods of procedure which influence profit in agriculture. Briefly stated, the factors which make for efficient farming are as follows: Large crop yields; Growing valuable crops; Amount of live-stock; Efficient live-stock; Efficient feeding of live stock; Large volume of business; Efficient use of man labor; Fitting power to farm needs; Minimum building and equipment costs; Efficient field and building arrangement; Diversity of production; Improved quality and better price; Farm budgeting; Farm bookkeeping.

IT is apparent that large yields per acre reduce the cost of producing a bushel or a ton of farm crops. Expenses of production remain fairly constant regardless of the yield, so that any yield secured over that required to pay expenses is clear profit.

While it is easily possible to be inefficient in the disposal of crops, yet I believe that the ability of the land to produce large yields is the first requisite of a profitable farm. In other words, those soils which, because of drainage or other physical conditions, can never be made to produce large yields, will always be a handicap to successful general farming. On such land, however, it is often possible to conduct poultry, orchard, or fur enterprises.

Large crop yields per acre are essential and also total crop yields per farm, which means that a large percentage of the farm must be tillable. The things that can be done to increase crop yields are: Use varieties and strains of seed which experiment stations prove to be high-yielding and of high quality; Use seed of high germination test; Use seed free from disease; Plant at the right time; Grow alfalfa, clover, or other legumes; Use all available manure; Use limestone and fertilizers as recommended by experiment stations; Be thorough in tillage and cultivation; And employ proper drainage.

The Farmer's Hope

FARMING is one of the oldest human industries, and probably because of this very fact it has, in many instances, changed but little as the years have rolled by. How can the farmer increase his profits? That is the question that many agriculturists are asking. The answer is at hand, if they will but heed the lessons taught by the younger industries. Increase crop yields per acre; make efficient use of live-stock; employ intelligently the excellent farming machinery that is available today; keep records that will point out the weak spots so that they may be eliminated. These and other points are forcibly brought out in the accompanying article written by a practical farmer who is making his farm pay.—*The Editor.*

Not only should valuable crops be grown, but the greater the acreage of these crops, the greater the income. For the corn belt, the most valuable crops are corn and wheat, alfalfa as the hay crop, and sweet clover as the pasture crop on tillable land. On tillable soil, the least valuable crops are oats, timothy hay, and blue grass pasture. It is quite evident that a per acre yield of four tons of alfalfa hay worth 20 dollars per ton is more valuable than two tons of timothy hay worth 15 dollars per ton.

WE can go back to the ancient Roman writer, Columella, for advice on alfalfa, for about this wonderful plant he wrote 2000 years ago:

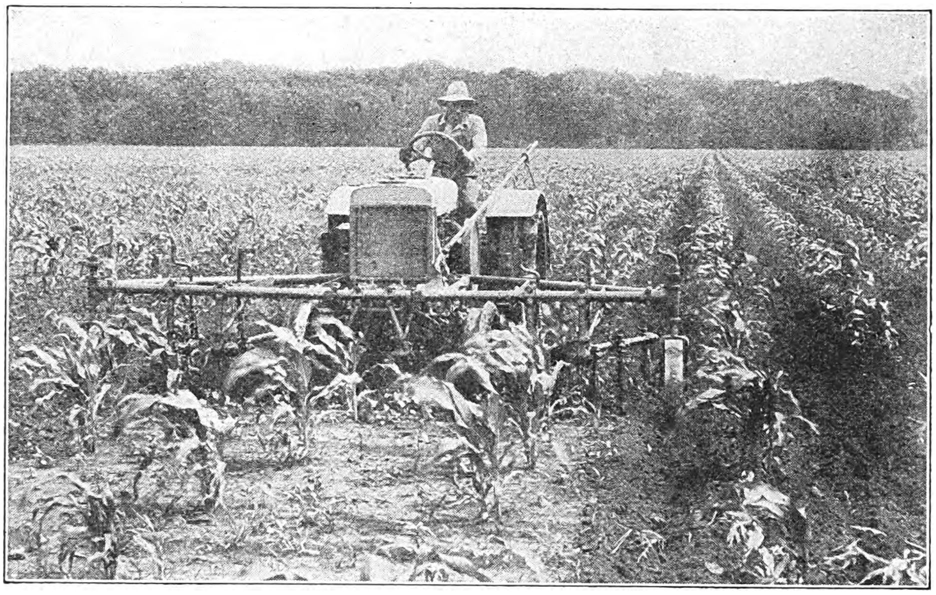
"Of all the legumes, alfalfa is the best, because, when once it is sown, it lasts 10 years; because it can be mowed four times, or even six times a year; because it improves the soil; because all lean cattle grow fat by feeding upon it; because it is a remedy for sick beasts; because a jugerum (two thirds of an acre) of it will feed three horses plentifully for a year."

Over a period of years those farms

which have the largest investment in live-stock have the best chance of profit. All other things being equal, it is usually possible to get a better price for farm crops when marketed in the form of living stock or live-stock products than when sold off the farm.

Except where there is a preferred market, it is not advisable to keep more live-stock than can be fed with the feed grown on the farm, for when feed must be purchased, freight charges must be added, and also a greater degree of chance is brought into the business, due to uncertain markets, and the necessity of a cash outlay for the purchase of feeds.

Probably the most important factor in successful live-stock farming is the ability of the live-stock to utilize feed in the production of meat or other products. It is essential that the live-stock be well-bred and free from disease. Young stock should be well-fed for proper growth.



THREE-ROW TRACTOR CULTIVATOR

With this, one man can cultivate 25 to 40 acres a day. Rigs are lifted, for turning at end of row, by a power take-off. Cultivator shovels follow wheels to obliterate wheel marks

IN the case of dairy cows, only those which are economical milk producers should be retained in the herd. The services of a Cow Testing Association are valuable in determining which cows should be weeded out and sold for beef.

Efficient feeding requires a knowledge of the proper mixing of feed rations as to protein and carbohydrate content. The feeder should know the percentage of various elements in feeds, and if he does not know how to balance rations, he can get help from his state experiment station or from farm papers. Protein is the most expensive feed and, since the legumes are rich in protein, the feeder will do well to grow a large acreage of sweet clover or other legume pasture, and alfalfa, soy-beans, or clover for legume hay. Live-stock will consume considerable roughage and feed which cannot be sold on the market at a price which will show a profit.

The goal of the feeder should be to secure the greatest return possible in live-stock products for every 100 dollars worth of feed consumed.

We have heard about the man who had such a large volume of business that he was able to sell below cost. While obviously not true, yet there is an advantage in large volume in farming as in any other business. The largest possible income per acre, and the greatest number of acres that can be operated under the system of management that is selected, promotes efficiency, but studies so far do not indicate that with diversified live-stock farming, there is any increased efficiency in favor of exceptionally large acreages. On farms devoted exclusively to grain raising, it is probable that much larger acreages can be economically operated. The problem of area is now being studied by engineers and economists, and the next few years should bring forth valuable information.

Dairying, hog-raising, and poultry production are the best enterprises for providing a larger volume of business without adding to the size of the farm.

The most successful farmers usually work a large number of acres per man, without reducing the yield of crops. In the corn belt the best farmers till about 90 acres of crops per man on live-stock farms. On some farms, it is doubtless possible for one man to tend a greater acreage, especially where the new general purpose tractors are used, with their larger equipment such as three-row planters and cultivators.

THE physical properties of the soil and the contour of the land have some influence on the efficiency of machines and power which in turn influences the number of acres that can be operated per man. It is possible, for one man to till the greatest acreage on grain farms. Since large yields per acre are essential to profit, there would be no advantage in increasing the acreage per man if less careful work resulted in lower crop yields.

It is possible to plan a rotation of crops that will distribute the labor throughout the season. In the case of corn and alfalfa, which are two of our most profitable crops, we have a labor conflict, especially at the time of harvesting the first alfalfa crop, but if it is possible to hire labor for a few days, it is profitable to do so, rather than to reduce the acreage of these two crops.

Raising live-stock helps to distribute labor throughout the winter. One of the economic problems of agriculture is the seasonal nature of the enterprises, and the inability to have continuous productive work all the months in the year is one that requires much study.

NO FARM RELIEF NEEDED HERE

The author standing in the edge of a cornfield on the farm which he manages. The stick he holds is marked off in half-foot spaces to indicate the height of scientifically grown corn

CUTTING THE WONDER CROP

Using a tractor mower to cut alfalfa. The mower is driven by power take-off from the tractor. This outfit can also be equipped with a side-delivery rake for clearing path for next round of the tractor in order that the hay already cut will not be matted by the wheels

It is necessary to keep the power and machinery costs per acre at a minimum. That horse labor is one of the major costs, often exceeding the cost of man labor per acre, is a fact not generally known to farmers. The feed that horses eat is usually raised on the farm and, for that reason, the cost of keeping horses is under-estimated. The extra horses that are kept to carry the peak loads of planting and harvest can, in many cases, be economically replaced with tractors. The writer replaced one team, used to hoist hay, with a three-drum hay hoist driven by a five-horse-power electric motor. This hoist has been used for 10 years and is more convenient and efficient than horses. The electric motor is also used to grind feed.

THE investment in power and equipment should be sufficient to do the work properly. Any excess, will, of course, cause loss.

The application of power to farm work is a subject which is now being studied by agricultural engineers. New machines and methods which will have tremendous effect on the future of agriculture, especially in crop production, are in process of development. Since live-stock production consists chiefly of breeding, raising young, feeding, and disposing of manure, it is evident that it is very difficult to apply labor-saving machines, especially power machines, to these enterprises.

The farmer can economize by keeping machinery properly housed, lubricated, and repaired, and by keeping only as many horses as are needed and feeding them according to the work done.

It is a fairly well established rule that, in the end, all expenses must fall on the land. Since unproductive acres are not able to bear any expense, all of the expense of developments or changes must go to the productive acres.

Another rather fixed rule, previously mentioned, is that usually it is unwise to keep greater numbers of live-stock than can be fed with the feeds grown on the farm. Roughly classified, there are three classes of land; That upon which cultivated crops can be grown; That which will grow pasture grasses; That which is unfit for either of the first two.

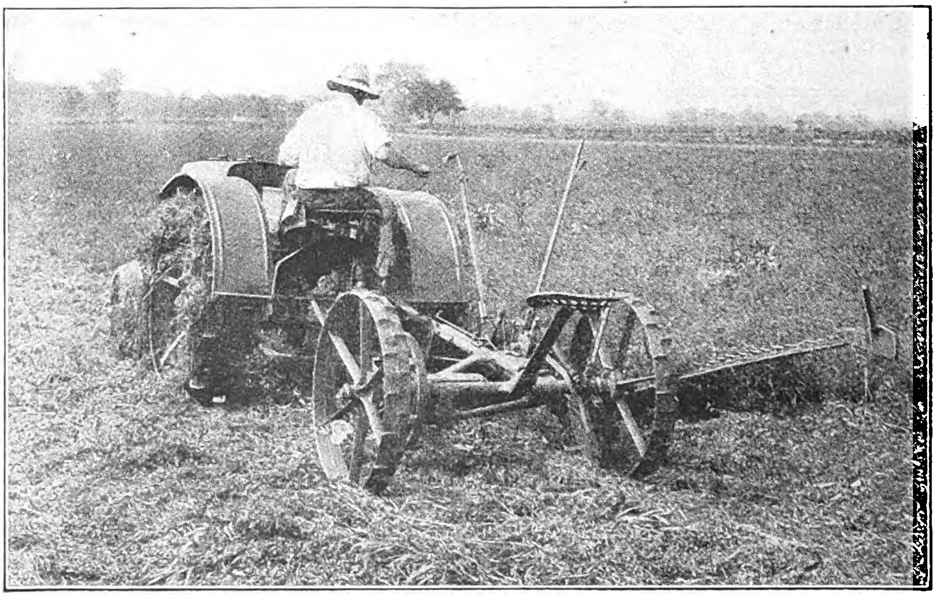
It is safe to say that the amount of live-stock is very definitely fixed by the number of tillable acres; a possible exception is poultry or some such special enterprise.

Therefore, since the amount of live-stock is limited by available feed, the investment in buildings is automatically regulated by the amount of live-stock to be housed. It is desirable to have a minimum building cost per animal. Any unused or unnecessary buildings are a useless burden upon the live-stock which must bear the building expense. It is an advantage to have a large acreage of tillable land over which the building cost can be spread. Building repairs and maintenance should be done with farm labor when other work is not pressing.

The farmer would do well to study some of the labor and time-saving methods that are the result of factory planning. Any arrangement of fields and buildings that calls for excessive idle movement of men, horses, and machinery is not economical. An average distance of 99 miles a month was walked to feed and care for the live stock during the winter season on a group of farms in Putnam County, Ohio. The range walked monthly per animal unit fed and cared for, was from 3.7 miles to 11.4 miles.

LARGE fields to permit continuous operation of machines without turning, with fields as near as possible to the farmstead is the ideal arrangement. Obviously, there is a limit to the distance between fields and buildings for the economical hauling in of crops and the hauling out of manure. The square farm would have an advantage over the same area spread out in a long narrow strip.

The arrangement of buildings and yards should be planned in advance of any construction work, and the plan should provide a location for any future buildings. Consideration should be given to distance of travel between buildings for man and horse, to access to buildings and bins with wagons, trucks, and manure spreaders, and to convenience in getting feed to live-stock and manure and litter away from them. Exercise lots should be adjacent to that part of the building



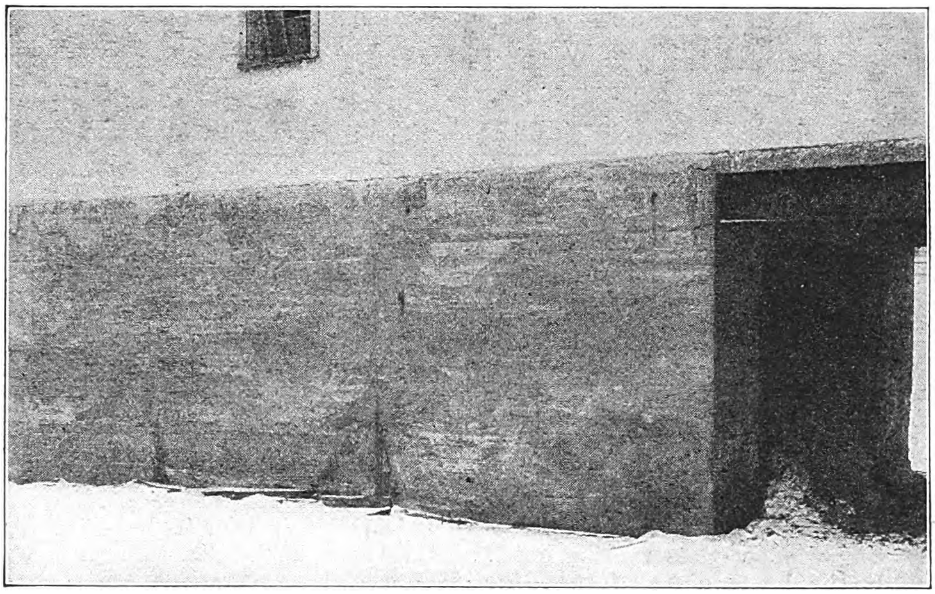
TRAILING A MOWER

This photograph shows how a general purpose tractor may be used to operate old style equipment: a six-foot mower which takes its power from mower wheels, drawn by a tractor which houses all of the farm animals.

There are many pieces of equipment such as overhead carriers, corn elevators and push trucks, which will save labor.

Fields and lots should be planned to use a minimum of fence, with permanent fences only where necessary.

During the past few years, those farms devoted chiefly to the production of grain have, as a rule, operated with a loss, with the exception of the wheat farms of the Northwest which are now in a prosperous condition. The low prices of grains are partly responsible for this. On the live-stock farm, there is a supply of manure, which helps to maintain soil fertility, while in the absence of manure on grain farms, there is a tendency to neglect the maintainance of fertility, with a resulting decrease in crop yields. Also, on live-stock farms there is usually a greater acreage of legumes grown which adds directly to the income, because they are high-profit crops, and, indirectly, because legumes benefit the soil for future crops.



AN EXAMPLE OF POOR PLANNING

This manure pit which is 30 feet long has only the one opening at one end. In loading a spreader, manure has to be carried by hand 30 feet to the door, when pit is nearly empty

DIVERSITY of crop production provides some protection against crop failure; distributes use of labor, power, and equipment; and controls plant diseases, insects, and weeds.

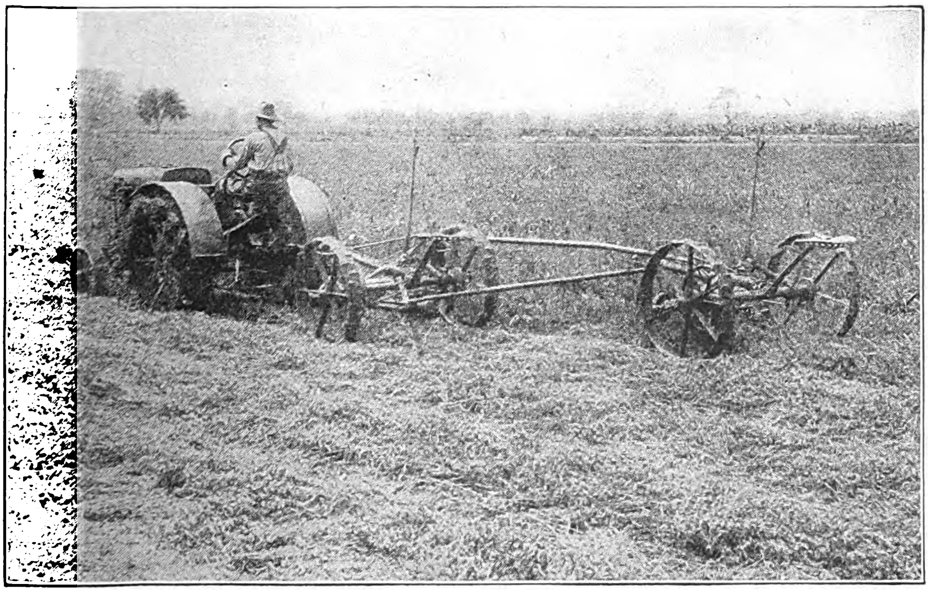
While some successful farms receive a large part of their income from one or two sources, yet diversity of income is generally desirable. It is apparent that if additional enterprises are successfully operated, they not only add to the total income and profit, but also bear a portion of the overhead expense.

It is a mistake to attribute too much importance to the factor of improved quality. While it is possible to secure somewhat better prices through improvement in quality, yet the increase in income is not so large as is generally believed. Those farmers adjacent to retail markets, where a premium is paid for quality, are only a small percentage of the total number of farmers.

There are locations where farmers can take advantage of quality markets for poultry and dairy products, and even stimulate these markets by proper advertising. Better prices can be secured by growing varieties of crops that mature early and have the chemical and physical characteristics desired by the market. Planting at the proper time on fertile soil, combating disease, and protection at harvest time, all have an influence on quality.

It is possible to feed live-stock so that it will be ready for market when prices are most favorable.

A farm budget will be helpful in planning future work. It should show the crops to be grown, the live-stock to be kept, and the estimated production, receipts, and expenses from the various sources. The budget is the business-like way to work out and record farm plans.



FAST WORK

Cutting a 12-foot strip of alfalfa with two mowers trailed behind a tractor. Although some trouble was experienced in turning with this outfit, it proved to be an efficient, fast rig

By means of a budget it is possible to compare the returns that may be expected from different systems of farming. In this way costly errors may be avoided. Budgets anticipate needed supplies such as seed, fertilizer, feed, and machinery.

The average farm represents a value of perhaps 25,000 to 50,000 dollars or more. With such a capital investment, it is necessary, from the standpoint of good business practice, to keep a set of books. The farm accounts should show in some detail the receipts and expenses. A complete record of the crops and other produce raised is desirable. An inventory of all feed and live-stock should be taken at the end of the year. It is doubtful if cost-accounting is necessary or practical, except in special cases.

MOST farmers can get help in farm accounting work from their county agents and agricultural colleges.

Farmers who are now successful are usually men of exceptional education who are capable managers. Men of similar ability in the industry world would receive much greater incomes.

Successful farmers have often spent years in improving their soil, developing efficient herds of live-stock, and in equipping their farms for economical operation. Some improvements can be made rather rapidly, while others, such as making the soil and herds more productive, may take several years. Even though it takes time to get results, the effort is not only justified, but is essential to complete success in the effort to increase the income from the farm.

Ultra-Violet Transmitting Glass—Has It Made Good?

Observations on the Physics and Physiology of Special Window Glass for Transmitting Indoors Part of the Vital Ultra-Violet Rays of the Sun, Based on the Opinions of Foremost Scientific Authorities

By ALBERT G. INGALLS
Associate Editor

IS THE new ultra-violet transmitting window glass making good? Is the home of the future—the school, the office, and the factory—to be equipped as a matter of course with this newly available kind of glass, or is it only a passing fad?

Questions of this kind are frequently received by the SCIENTIFIC AMERICAN. They come from people who have considered purchasing this glass—from owners of homes, especially the parents of infants and growing children; from members of school boards who wonder what decision to make where the installation of the glass in school room windows has been under discussion; from the directors of hospitals and sanitariums who wonder whether its installation would soundly justify the extra expense; from the heads of industries who are trying to decide whether employees in office or factory would lose less working time because of colds and sickness and possibly show more "pep" in their work if placed behind ultra-violet transmitting glass; and from other people, difficult to classify, who merely want to know.

AT the present time no simple, clean-cut, unqualified answer of the "yes" or "no" type can be given to these questions. The science of outdoor sun therapy is young, and that of sun therapy through ultra-violet transmitting glass is younger. Although some of the best physicists are daily performing research on this kind of glass, and many of the ablest specialists among physicians are as constantly watching its biological effects on man and animals, much still remains to be learned. A large part of the statements to be obtained from scientific authorities must as yet be in the nature of opinions, not dogmas.

Certain conclusions, however, already begin to emerge. Of these the broadest is, that ultra-violet transmitting glass is doubtless destined to have a permanent future for health purposes, but that its usefulness is likely to be more limited than some of its more enthusiastic proponents now think. To overdo the claims for its benefits will, it is thought, do the glass lasting injury. If too high expectations are engendered, they cannot be made good; a reaction may follow and many people may conclude that ultra-violet transmitting glass, with ultra-violet treatment, has been entirely a fad.

Opinions which the SCIENTIFIC AMERICAN has just gathered from the ablest authorities, both physicists and physicians, who have done scientific research in the ultra-violet, quite clearly point out that in some instances too broad claims have been made for this glass. Other evidence indicates that not all claims made are exaggerated, as the reader might unjustly infer from this statement, but that some of them can be made good wholly, while others are scarcely warranted at all. In short, there is almost certainly a place for the new glass, but the present indications are that this is not every place.

TESTING CARBON ARC

Dr. W. W. Coblentz of the Bureau of Standards conducting a test on a carbon arc lamp which is situated at his left side and is shining through the dark hole, *h*, in the asbestos screen in front facing the observer. Note screen for eyes

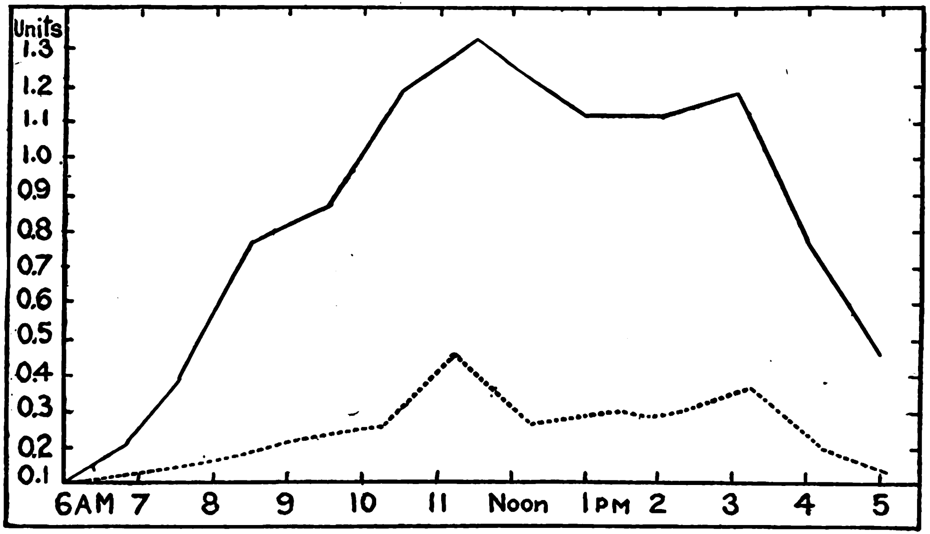
Although the medical journals and some of the technical publications having a limited circulation have kept the scientific worker himself well informed concerning progress in the work during the past year or two since ultra-violet transmitting glass became available to the public, no authoritative summary of the subject, except several written from a single writer's point of view, has yet been put in the hands of the public. It was therefore decided to place the matter, in a formal questionnaire, before a number of the best-known authorities on the subject and to publish their replies in the SCIENTIFIC AMERICAN. Unfortunately this has not proved practicable, because the replies are too long; also because virtually every aspect of the subject, still young as was emphasized above, is very largely a matter of opinion, or, more precisely, of many shades of opinion, and it has proved impracticable to render a classified summary of the different opinions offered in the whole Questionnaire.

IN the exact sciences it is possible to answer a question by yes or no. In many other sciences a definite yes or no answer to the majority of questions is possible, but when dealing with ultra-violet transmitting glass there is a large variety of factors, most of which are variable, and the answers to specific queries are usually contingent on the nature of these variables. Such variables, for example, are locality, latitude, altitude of station, time of day, degree of local pollution of atmosphere or freedom from pollution, local variation in sunshine, purpose for which the glass is to be used, size of glazed areas, variety of special glass, direction the window faces, areas of skin exposed to sunlight, condition of patient, and others, each of which must be carefully weighed before statements concerning the glass can be brought under anything approaching a definite scientific law. As Dr. Charles Sheard of the Mayo Clinic puts it, "Mr. Heinz with his 57 varieties of pickles has nothing on the biologist, bio-physicist and bio-chemist as they endeavor to draw conclusions relative to the effects produced by such an agent as ultra-violet light."

Notwithstanding that the replies to the "SCIENTIFIC AMERICAN Questionnaire on Ultra-Violet Transmitting Glass" are too long to publish here, they will be made available in pamphlet form and in the exact words of the noted scientists who so willingly provided them, if the response from our readers is sufficient to justify their preparation. This procedure, if warranted, would enable those who are interested to derive their own estimates of ultra-violet transmitting glass at first hand from the best scientific authorities available at the present period.

AMONG those whose detailed replies have been received are Dr. A. F. Hess of New York University and Bellevue Medical College, who first demonstratedthe curative effect of sunlight in rickets; Dr. Henry Steenbock of the University of Wisconsin, whose researches on the biological effects of ultra-violet have won him world-wide fame among scientists, and whose discovery that foodstuffs could be given antirachitic properties by direct irradiation with ultra-violet rays forms the basis of the "million dollar" patent which he generously donated to the world under legal safeguard calculated to guarantee it against sensational unscientific exploitation; the physicist Dr. W. W. Coblentz, specialist in radiometry, Chief of the Radiometry Section of the United States Bureau of Standards, the scientific accuracy of whose official laboratory determinations of the transmission of ultra-violet rays by all kinds of glass was voluntarily commended by many of the other scientific authorities who replied to the Questionnaire; Dr. Walter H. Eddy of Columbia University, who has performed extensive research on animals and human beings behind ultra-violet transmitting glass, and who has written extensively on the subject in magazines read mainly by mothers of children; Dr. M. Luckiesh, Director of the Lighting Research Laboratory at the National Lamp Works of the General Electric Company, author of "Ultra-Violet Radiation" and co-author with Dr. Pacini, of "Light and Health;" Dr. Janet H. Clark of Johns Hopkins University, whose recently published laboratory determination that a child would receive as much ultra-violet vitalizing rays in two minutes out of doors in noon sunlight as in 20 hours when seated 16 feet from a north-facing window glazed with ultra-violet transmitting glass has had possibly more effect on the opinion of other scientists than any other pieces of recent evidence concerning this kind of glass, and, in the opinion of some, has injured its distribution more than any other factor; Dr. Leonard Hill of the National Institute for Medical Research, London, widely recognized as the ablest authority in Great Britain on ultra-violet in connection with health; Dr. Charles Sheard of the Section of Physics of the famous Mayo Clinic, noted bio-chemist and research worker; and numerous others.

Several varieties of ultra-violet transmitting glass and flexible glass substitutes are now readily available for use, some of these being obtainable in standard window-glass sizes, either transparent or translucent. As far as appearance goes it is not easy to distinguish some of the transparent varieties from common window glass. Why these special glasses transmit the desired shorter wavelengths of the ultra-violet is partly a trade secret, but the main reason is that every possible precaution is taken in the manufacture to avoid contamination with iron. It is this element, contained in common window glass, which absorbs these valuable wavelengths, preventing them from coming indoors.



Courtesy *Journal of the American Medical Association*

SUNSHINE AND SKYSHINE

Intensity of ultra-violet radiation of the sunshine and skyshine, respectively, at Boulder, Colorado, during the day of June 30, 1928; solid line, sunshine (12 observations); broken line, skyshine (12 observations). The relative intensity is measured in zinc sulfide units

What is ultra-violet light, radiation, rays, or waves, as it is variously and correctly termed? This simple question and its answer may perhaps insult the reader's intelligence, but there is nevertheless enough existing evidence that this point is not widely understood to justify a homely explanation.

Everyone is familiar with the so-called spectrum of light. A glass prism produces such a spectrum. If a sunbeam be allowed to fall on such a prism its component colors are sorted out by the glass and we see them in the familiar spectral series—red, orange, yellow, green, blue, violet. This, however, is not the whole of the spectrum of sunlight; it is only the part which our eyes are adapted to perceiving. Easily performed experiments show us that this visible spectrum of light has two invisible "annexes," one on either side. On the side adjacent to the red is the infra-red, a synonym for radiant heat. This can be had from a common electric bathroom heater. If we could see the solar heat spectrum we should find it several times as extensive as the visible spectrum.

On the side adjacent to the violet end of the visible spectrum is another "annex," equally invisible to the human eye, although some animals can see a portion of it. This is the ultra-violet.

Why our eyes perceive only a fraction of the sun's entire spectrum is possibly due to the fact that Nature, always economical, was able to devise the sense of sight without using more of it. Why a middle instead of some other portion of the spectrum was chosen is possibly because more radiation from the sun reaches the earth in that precise portion than in any other.

How are we to visualize a part of the spectrum, the ultra-violet, which we cannot see? It cannot be visualized, any more than a man blind from birth can visualize green, yellow, or any other color. It is possible, however, to form a definite mental concept of ultra-violet light by a simple analogy with visible light.

THE latter consists of vibrations or waves, very rapid and very short from crest to crest. It will help to think of tiny wavelets advancing across a basin of water. (This analogy is not exact, but the popularization of science often justifies cutting a few corners to avoid confusing some of the readers with exceptions, ifs, and ands).

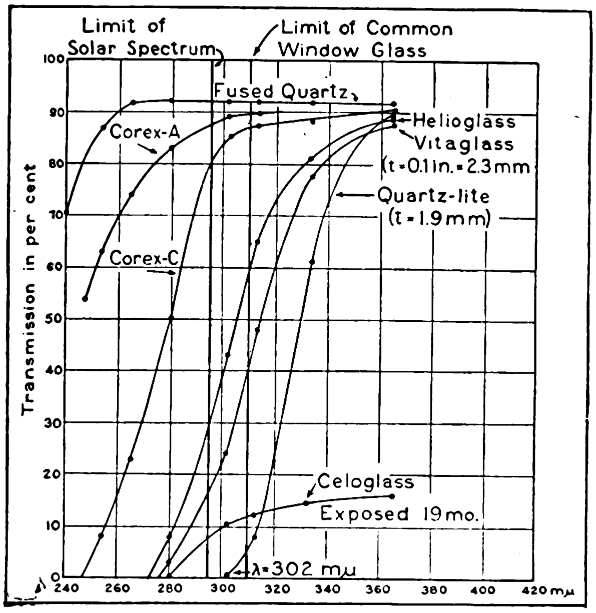
If we had on our basin of water a number of waves of several different lengths, superimposed on one another and all moving in the same direction at the same time, we should have a fair analogy with ordinary sunlight. It is a mixture of waves of different lengths. In such an analogy the "red" waves would be about twice as long from crest to crest as the "violet" waves at the other end of the visible spectrum. Between these lengths would be waves of all intermediate lengths, giving not only orange, yellow, green, and blue light, but the intermediate gradations of each color actually discoverable in a closely examined spectrum of sunlight.

Carrying our water-wave analogy into the ultra-violet radiation of sunlight, what we have here are simply waves of the same kind which are still shorter from crest to crest than any in the visible spectrum. Even ultra-violet waves are not, however, all of equal length, any more than those of the parts of the visible spectrum. They are of *all lengths* intermediate between that of the longest visible violet wave, and waves about three fifths as long as that wave. This is the solar ultra-violet spectrum. It will be important in the most elementary consideration of ultra-violet light to remember that its waves are not all of equal length, and that their variation in length has a deep significance in physiology and therapy.

IN sum, then, it is wholly accurate to think of the sunbeam that streams into an open window as being composed of an immense number of extremely minute waves of quite widely different lengths, the longest being heat (infra-red) waves, those of a medium length being visible light and the shortest being ultra-violet, all forming a graded series. All these waves are *identical in nature, differing in only one respect*—wavelength. The fact that many have been led to regard heat, light, and ultra-violet radiation, as intrinsically different is perhaps due to the fact that they happen to act differently on our different senses, and that they act in a different manner with regard to various substances—passing through certain of these substances but not through others, for example.

This much has been explained in order to offset a belief that has become rampant, especially since the market has become flooded with ultra-violet lamps—namely, that ultra-violet rays are something physically quite different from visible light, and especially that, whatever they are, they are all essentially alike, as if they were something squirted out of a hose. Thus, a variety of ultra-violet transmitting glass might have a high transmission "*in* the ultra-violet," without being appreciably better than common window glass. What we must know about any variety is its transmission in a certain *specific part* of the ultra-violet—certain bands of wavelengths. If this fact were well and widely understood it would simplify greatly the difficulty of making apparent why one variety of glass may be superior to another kind, and why certain statements which have been made are misleading.

It is not necessary to become a physicist in order to grasp the main features or landmarks of the solar ultra-violet spectrum. A careful study of Figure 1 will not only make clear these landmarks, enabling the reader who does not already understand them to follow technical articles about the subject and to understand a common spectrogram (likely to become increasingly common), but will make considerably plainer the specifications of ultra-violet transmitting glass. Incidentally it will help the reader to interpret the available literature on ultra-violet lamps. This figure or graph will therefore be discussed through several paragraphs.



ULTRA-VIOLET SPECTRAL TRANSMISSION

Figure 1: Prepared by Dr. W. W. Coblentz, mainly from published data obtained under his direction at the Bureau of Standards. The curves give general, comparative transmissions of average solarized samples after exposure to the sun for 12 months. The letter *t* refers to the thickness of the glass. The significance of the entire chart is explained in the text. The curve for Cel-O-Glass shows transmission that passed straight through the sample into the spectrometer slit, no corrections having been made for diffused rays. Such a correction would increase the transmission of this glass substitute by several percent

The term "ultra-violet transmitting glass" as applied to the new glasses was not well chosen, for all ordinary window glass transmits ultra-violet rays, and actually the majority of the wavelengths of the ultra-violet of the sunlight—specifically about five sixths of these wavelengths. In spite of this fact, it is the small remaining minority of the ultra-violet waves of sunlight, the shortest ones, which we are perhaps most anxious to get—especially in the cure or prevention by sunlight of the bone deficiency disease of infants called rickets (bow legs, knock knees, pidgeon chests, short chins, chalky teeth), for here no others will suffice. Ordinary window glass happens to exclude all of these same short wavelengths which are so highly prized. It is not transparent to them. It entirely absorbs them. On this all authorities, both physicists and physicians, are agreed. It is axiomatic.

Referring again to Figure 1, the numbers 240, 260, and so on, across the bottom of the graph, indicate in minute fractions of a millimeter the various wavelengths of the radiation; for example, 240 means 240 millimicrons, a millimicron being the millionth part of a millimeter. Incidentally, we now see that light waves are extremely short; our analogy of the basin of water was greatly overscaled.

At the extreme right of the diagram the number 420 millimicrons falls within the visible part of the spectrum, in the violet. The violet begins where the visible spectrum begins, at 390 millimicrons, and extends to the right, off the scale. At the extreme left of the diagram the number 240 millimicrons lies far within the ultra-violet—farther in fact, than the sun's radiation ever extends. Waves of this length may be obtained only from artificial sources.

Between these limits are three "landmarks," each indicated on the diagram. These should be noted carefully because they figure prominently in every discussion of solar ultra-violet ray treatment which goes beyond the most elementary stage. These landmarks are (1) the approximate short-wave limit of the solar spectrum at wavelength 295 millimicrons; (2) the point 302, that of a certain band of wavelengths having marked antirachitic properties; and (3) the limit of common window glass at wavelength 310 millimicrons—the second heavy vertical line.

SINCE waves shorter than (that is, to the left of, in the diagram) 295 millimicrons are not contained in sunlight, and since waves longer than 310 millimicrons are already transmitted by common window glass, virtually our entire attention in considering the value of ultra-violet transmitting glass, will be centered on the wavelengths between those limits, indicated by the two heavy vertical lines.

These, the shortest of the ultra-violet waves of sunlight, are vital to health, especially in the cure and prevention of rickets. Many writers, and some salesmen of ultra-violet transmitting glass and ultra-violet emitting lamps, have called them the "vital" or "vitalizing" wavelengths. As the entire solar spectrum is relatively vital, a more scientific, less misleading description of this part of the ultra-violet spectrum would be simply "solar waves which are not transmitted by common window glass."

The *total* solar spectrum extends all the way from 295 millimicrons on the left, through 95 millimicrons range of ultra-violet wavelengths, 380 millimicrons of visible wavelengths and about 3000 millimicrons of infra-red wavelengths—a great gamut of 3500 or more millimicrons in range of wavelengths, of which all but 15 millimicrons already passes through common window glass. Therefore, the reader may ask, why worry at all about special glass? However, many experiments with human beings and animals made during recent years by many research workers, in which access to ultra-violet radiation of wavelengths not transmitted by common window glass, or its equivalent in some other form, was denied, have provided decided cause for such worry. Narrow as this special band of wavelengths is, it is one of the vital needs of the physiological organism.

HOW it happens that common window glass comes so exasperatingly near to transmitting the whole spectrum of solar radiation yet does not actually accomplish that feat, often perplexes those interested. The reason—impurities in the glass—has already been explained, and it seems almost like a case of the proverbial "cussedness" of inanimate objects. However, this bit of "cussedness" can be and is gradually being removed, for several varieties of ultra-violet transmitting glass are already available. Also, time and improved processes of manufacture are likely to see an increase in the percentage of the ultra-violet they transmit.

The logical answer to the question, why it is that common glass transmits nearly but not quite all the vital wavelengths, may, then, ultimately prove to be one of performance on the part of the glass industry—*better glass.* Thus at some future time "common" window glass may acquire a new definition. Common glass will be defined as "glass that transmits a high percentage of the radiation in *all* the wavelengths of natural sunlight." To quote Dr. W. W. Coblentz of the Bureau of Standards: "No doubt in a few years, new ultra-violet transmitting glasses will be a common article of commerce, costing little more than common window glass."

Thus far the reader has been given no reason to suspect that the band of solar wavelengths not transmitted by common window glass, but partly transmitted by certain available special glasses and flexible glass substitutes (see curves in Figure 1), is not invariable in width in all circumstances. It is a fact, however, that even this range of wavelengths, or some part of it, is frequently lacking in natural sunlight. At such times there is a corresponding loss of advantage derivable from ultra-violet transmitting glass. Also, wherever the rays are totally lacking in the sunlight they may not even be had by going out of doors, a fact which some appear to have overlooked. Atmospheric pollution; altitude of the station above sea level; altitude of the sun (angle above horizon), latitude—these are the factors which control the volume or total intensity of these rays. First; smoke, dust, and moisture filter out the sun's short waves, depending on the amounts present. And the shortest waves, because they are the least penetrative, are the first ones to go. Second; the lower the altitude of the sun, due to the hour of the day, the longer the path of the ray, even in clear atmosphere, hence the greater the loss. When compounded with atmospheric pollution this effect is enhanced. Third; the sun's altitude above the horizon, due to the changing seasons, also influences the length of the path its rays must traverse before reaching the earth. If the sun's altitude is high, as in summer, this path is shortest, but when the sun's altitude is low, as in winter, it is very greatly increased in length, the two effects, those of hour and season, being compounded at such times. Often all three effects are compounded. How this works out is shown in Figure 2. Obviously, high latitudes would add a further factor at all times, because the sun's rays would reach the earth still more obliquely; but lower latitudes would favor the ultra-violet, all other things being equal. Altitude of the station favors the ultra-violet.

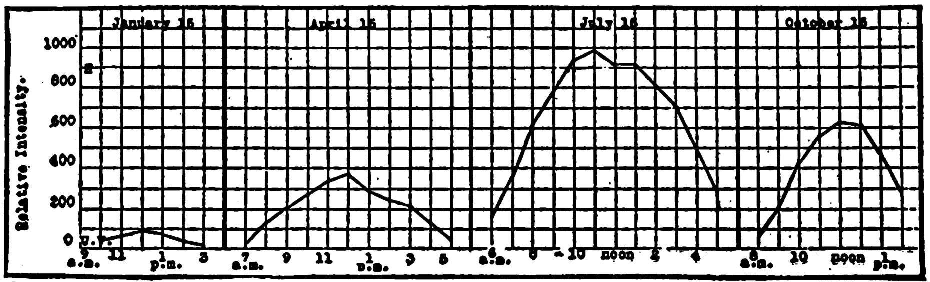
With these factors conspiring more or less to diminish the special advantage of ultra-violet transmitting glass, is it to be wondered that many research workers, physicians, and others, are now demanding glass which transmits the highest possible percentage of the short-wave radiation which reaches the earth's surface?

Chicago furnishes an interesting example of the effect of atmospheric pollution, compounded with the winter sun's low altitude. Doctors Bundeson, Lemon, Falk, and Coade, of the Department of Health of that city, measured from day to day throughout the winter of 1926-1927 the lower limit—that is, the short-wave limit—of the ultra-violet detectable in sunlight. The records begin November 28, the shortest waves of that day having a length of 303.5 millimicrons. This does not even uncover the rickets-protecting landmark at wavelength 302. This is a potent anti-rachitic wavelength, although recent research conducted at Cornell University by Dr. George H. Maughan indicates that a still lower one at 296.8 millimicrons is perhaps four times more effective.

ALL through the month of December, and until February 11th, the Chicago experimenters did not once record a wavelength shorter than 303.5 millimicrons. From that time on, the radiation was shorter than 302, and may therefore be termed available anti-rachitic radiation. By April it stood mostly at 300, and on May 16 it had reached 299, and doubtless remained mainly below that position all summer.

Winter and atmospheric pollution thus cheated Chicago out of part of its claims on the ultra-violet. The same conditions exist in a relative measure in other cities. In general, the amount of ultra-violet in the country is 50 percent more than in the city. The four physicians who conducted the experiments reported to the American Medical Association that "comparatively little ultra-violet radiation of known physiologic significance appears in the sun's spectrum in the winter months in Chicago. The ultra-violet rays are absorbed to a significant degree by smoke in the atmosphere.

On the other hand, experiments conducted on rats by Captain William D. Fleming of the Army Medical School in Washington, D. C., clearly indicate that Vitaglass protects these animals to some extent against rickets in that locality in the winter months. As Washington is clean and comparatively free from atmospheric pollution,



Courtesy *Journal of the American Medical Association* (After Dorno)

VARIATIONS IN THE ULTRA-VIOLET RADIATION OF THE SUN

Figure 2: This chart gives a general idea of how the daily and seasonal effects are compounded at different times. These effects are fully described in the accompanying text

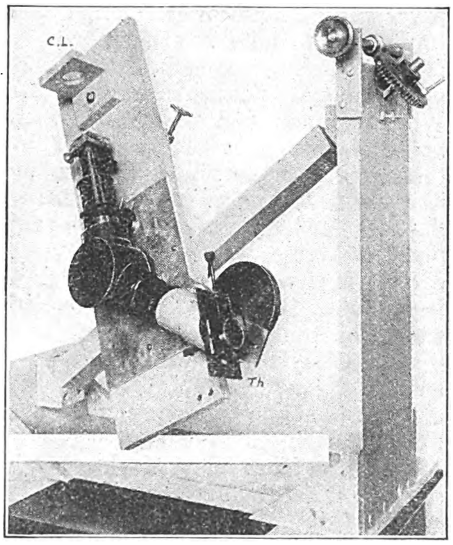
as well as farther south than Chicago, it may perhaps be taken as an example of a place where good results may reasonably be expected from ultra-violet transmitting glass when used under otherwise advantageous conditions.

In making experiments on the biologic effect of radiation filtered through glass it is difficult to reduce all the existing factors to parity. Animals such as rats and chickens are more easily managed than human beings, who cannot often be penned up for months behind ultra-violet transmitting glass while another control group of persons is similarly incarcerated behind common glass, fed a rachitic diet and allowed to develop rickets until its members cannot stand up. Most authorities agree that the observations made from experiments on animals apply to human beings, although several state in their answers to the Questionnaire that these observations would apply only if the human beings were kept naked like the animals, so that they might absorb a corresponding amount of radiation.

ANOTHER variable factor in making tests with human beings, often a large one, is the psychological element. Even if one endeavors to make one's observations scientifically and without bias this is difficult to avoid. To test the psychological factor in one case, the writer, in the interests of science, played a reprehensible caper on a member of his own family. Offering to bring home a window of an unnamed ultra-violet transmitting glass and install it in a south facing window behind which this member habitually sits, a pane of common window glass was secretly purchased instead. While the putty was being removed in order to replace the old pane the subject of the experiment unexpectedly left the premises. This "assist" permitting a further piece of skullduggery, the old pane behind which she had sat so many years was not even removed, but fresh putty was substituted for the old, and the glass was smeared with oily hands in order to complete the verisimilitude.

The subject in question had previously stated that she was quite well. Apparently she permitted the installation to be made on general principles, and without knowing what specific benefits might be expected to accrue from the glass. Although scrupulous pains were subsequently taken not to ask the subject of this depraved experiment any leading questions, or to coach her on what exact effects might be expected from the glass, she has repeatedly volunteered the remark that "this glass is *very* much better than the old glass. It burns my scalp right through my hair." Numerous remarks of similar nature, to which other members of the family have added emphatic concurrence, have been heard. For example: "This glass is far warmer than the old glass—that is *certain*." (Ultra-violet rays are not heat rays.) The writer's next great problem will be to prevent a copy of this article from falling into the hands of his family.

This experiment in human psychology speaks for itself, regarding the difficulty of obtaining accurate scientific observations on ultra-violet transmitting glass when the subject of the experiment is permitted to know that a test is being made upon him or her. The psychological factor is difficult to eliminate. Tests of ultra-violet transmitting glass made on school children should therefore be made without the least inkling on the part of children or teacher. Testimonials based on such tests as this have, however, been used in some cases as an argument favoring the purchase of ultra-violet transmitting glass.



MEASURING ULTRA-VIOLET

Some years ago this instrument, the spectropyrheliometer, was devised by Dr. W. W. Coblentz for measuring the ultra-violet rays in sunlight. It consists of a fixed arm spectrograph, having lenses and a prism of quartz, mounted upon a polar axis to follow the motion of the sun. An image of the sun is focused upon the spectroscope slit by means of a cylindric quartz lens, "C. L." shown in the upper left-hand corner. The intensity of the ultar-violet spectrum is measured by means of a thermopile, "Th," shown to the lower right. This device is being used to study the amount of ultra-violet vitalizing rays in the sunlight

Perhaps the most frequent inquiry is whether the glasses are beneficial enough to justify their installation at present prices in windows which do not directly face the south. Drs. Tisdall and Brown of Toronto ascertained by experiment, and stated in the *American Journal of Diseases of Children*, that "the anti-rachitic effect of skyshine (reflected rays from the sky and clouds) is approximately from one half to two thirds as great as that produced by what is ordinarily termed sunshine (rays from the sun plus the reflected rays from the sky)." Asked whether they considered that the installation of ultra-violet transmitting glass was justifiable for north, east, and west windows, those who answered the Questionnaire gave various answers. Examples of these are: Dr. Leonard Hill (London)—"The U-V comes much more from skyshine of *whole* sky than from direct sun. But the glass is not of value in ordinary windows." Dr. Charles Sheard (Mayo Clinic)—"In general, would recommend it for south windows only." Dr. Janet Clark (Johns Hopkins University)—"I am sure it is no good except in south windows." Dr. Alfred F. Hess (New York University)—"Depends upon location, exposure of room, area of exposure of skin, and so on." Professor Harry Steenbock (University of Wisconsin)—"I do not consider the ultra-violet transmitting glasses of sufficient value to warrant their installation in other windows than those of southern exposure. In fact, I do not consider that their installation in the latter is justifiable except for special purposes." Dr. Lawreson Brown (Trudeau Sanitarium)—"I question very much the advisability of putting in this glass in the northern part of this country. Exposure out of doors for a few moments is so much better for children than exposure behind the special forms of glass that there seems to be no reason for them. In nurseries and hospitals where you can have a solarium composed of such glass, I think it might be useful. I certainly have seen children tan behind it."

SO far, the noes have it. Now come some of the ayes: Dr. David C. Hall (University of Washington)—"I believe the south and the east windows are the best, but the west helps greatly and the north less. I also believe there is considerable value to be obtained even in the absence of direct sunlight." Dr. C. E. K. Vidal (Montana State Tuberculosis Hospital)—"Positively yes." Dr. Norman E. Titus (New York)—"Yes." Dr. F. H. Slayton (American College of Surgeons)—"Yes." Professor Donald C. Stockberger (Massachusetts Institute of Technology)—"Yes. Probably a little ultra-violet entering each of a number of windows would add up to an intensity of some value." Dr. E. V. McCollum (Johns Hopkins University)—"Yes." Mr. F. E. Lamplough (England—inventor of Vitaglass)—"East and west windows will at times receive a considerable amount of sunlight. In the case of north windows it is desirable that these should be of good size and the user should be fairly close to them in order to obtain considerable advantage."

Other answers favorable to the glass are those of Dr. Earl H. Mayal (Brooklyn)—"Yes, I believe experiments have proved this." Mr. T. B. Kidner (consultant on institutional planning, New York)—"Yes, undoubtedly." Dr. Edison Pettit (Mount Wilson Observatory)—"Yes. In all cases of school, office, shops, and so on, where the worker, by the nature of things, cannot stand in sunlight anyway, it is the sky radiation from which he will get his ultra-violet light."

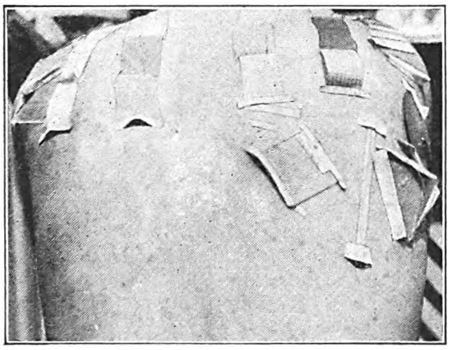
Less positive and in some instances more detailed answers come from Dr. H. P. Gage (Corning Glass Works, makers of Corex)—"East and west windows often receive considerable sunshine. The value of north skylight received through a somewhat limited north opening is as yet uncertain." Dr. Frederick F. Tisdall (University of Toronto)—"Our experiments with skyshine showed that exposure of rachitic rats to the sky's rays coming through an ordinary sized window glazed with one of these special glasses produced very little effect. This can be figured out mathematically. We showed that our source of ultra-violet rays is approximately 50 percent from direct rays of the sun and 50 percent from the sky.

"IF we install a special window on the north side of the room the ultra-violet rays available are at once reduced the 50 percent which comes from the direct rays of the sun. The other remaining 50 percent, that is the rays reflected from the whole sky, are further reduced to that percentage of the sky which we can see through an ordinary sized window—which of necessity is not more than 10 percent. Therefore, we have available as our outside source of ultra-violet rays one tenth of 50 percent, which equals 5 percent. This 5 percent is further reduced by passage through the glass by about 50 to 75 percent; in other words a patient or an individual sitting in a room four or five feet from an ordinary sized window on the north side glazed with special glass receives only from 1 to 3 percent of the ultra-violet rays that he would receive if he were outside."

Dr. Edward B. Vedder (Army Medical School)—"Yes, in cases where user can get no direct sunlight. It is obvious that this applies to very few individuals who are permanently bedridden." Dr. Bernard L. Wyatt (Desert Sanatorium, Arizona)—"That would depend on whether the user was sick or well, his economic circumstances, the latitude in which he lived, dimensions and arrangement of room, and the atmospheric transparency. Certainly 'no' for north windows." Dr. M. Luckiesh (Director, Lighting Research Laboratory, National Lamp Works, General Electric Co.)—"With the scanty knowledge available at present I would not recommend that a special glass for transmitting ultra-violet radiation be used excepting where direct sunlight is available." Dr. Brian O'Brien (Buffalo Tuberculosis Association)—"I would seriously question the installation of special glass transparent to ultra-violet light in north and other windows not receiving direct sunlight. In certain isolated cases it might be worth doing, but considering all published data it does not appear economically sound."

If any deduction might be made from these conflicting opinions and from others not quoted here, it is that the installation of the glass is at least more likely to prove justifiable in other positions than in direct south light, if it is spread over the sides and top of a solarium; rather than when the light must be received through an ordinary window which permits radiation to enter from less than one side of a room.

Dr. Walter H. Eddy (Columbia University) furnishes a peculiarly practical opinion—"I have objected to the installation of glasses in school rooms, as in the case of Bronxville, as a waste of money. Clothed children sitting away from the windows would get little ultra-violet, regardless of the windows used. I believe the Vitaglass panes have a valuable use in cases where persons can undergo exposure on the nude skin. In homes they would permit the baby to lie in his crib, nude, in the direct path of the rays, and this would save much perambulation, especially when perambulated babies are too often swathed to the nose with ray-absorbing clothing." ("The fear of injuring infants' eyes," says Dr. Charles H. Smith of the Children's Hospital, New York, "is responsible for most rickets and tetany.")



A SIMPLE TEST

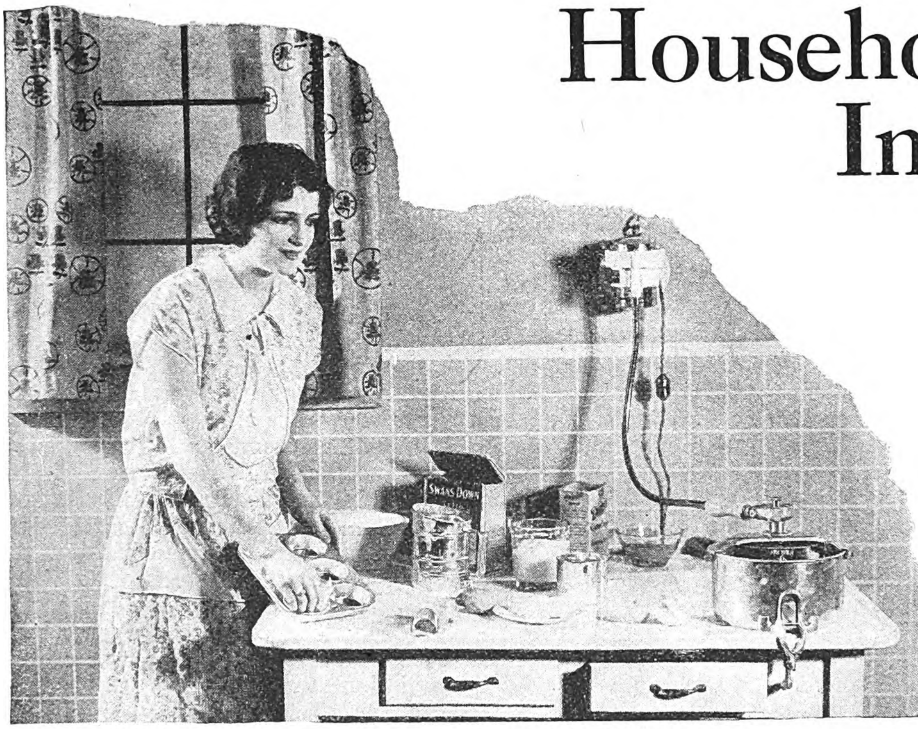
Anyone can make this simple test of the ultra-violet transmitting properties of various materials. Pieces of window glass, quartz, ultra-violet transmitting glass and glass substitutes, fabrics, and so on, are attached to the skin which is exposed to the midday sun. The covered areas will be affected (*roughly*, not accurately) in proportion to percentage of short-wave radiation transmitted, observation to be delayed 24 hours. The vertical streak over the spine was a substance to protect bathers. In this particular test, it proved to be effective

It is interesting to note that those by whom the Questionnaire was answered may be divided roughly into two categories—those who have performed much original research upon ultra-violet transmitting glass and its effects, and others. It may be more than a coincidence that the great majority of the unfavorable responses proceeded from the former category.

OTHER interesting considerations having to do with the ultra-violet might be answered by quotations from replies to various questions on the Questionnaire. One of these bears on the deterioration of ultra-violet transmitting glass. Apparently the suspicion has become widespread that this glass soon loses all its power to transmit the short wavelengths it is designed to transmit. The foundation of this suspicion is doubtless the fact that the potent ultra-violet rays themselves react chemically on impurities in the glass, mainly iron compounds, and that the products created by this photochemical reaction absorb and shut out some of the very same kind of radiation which brings about the change. What actually does take place is not total deterioration—as has been widely whispered—but only *partial* deterioration. As stated by Dr. W. W. Coblentz (Bureau of Standards)—"Solarization tests extending over a year of exposure to sunlight in Rhode Island, Texas, Arizona and Washington, D. C.—also accelerated deterioration tests under the carbon and the mercury arc (with and without filters)—show that all the special window glasses now marketed for transmitting ultra-violet solar radiation, decrease in transmission to a fairly constant value, which appears to be permanent." Dr. Charles Sheard (Mayo Clinic) states: "Such glasses lose some of their transmissive properties for ultra-violet but in the course of a few months become stabilized to all intents and purposes." The curves in Figure 1, it will be noted, are for glass *after* exposure to the sun for 12 months.

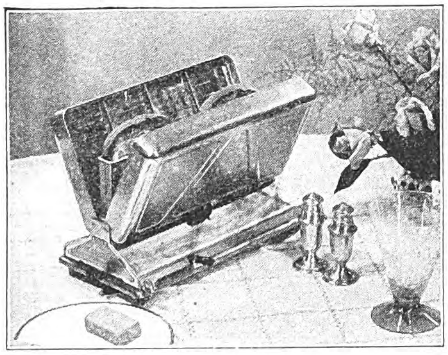
As emphasized early in this article, what we have available at present is not a set of definite, conclusive, finished scientific laws concerning ultra-violet transmitting glass and its uses, but mainly a large body of opinions. In these circumstances some portions of the public will incline to follow the rather negative opinions, while others will doubtless lean toward the affirmative. Dr. N. K. Chaney (National Carbon Co. Research Laboratories) perhaps best characterizes the present situation when he replies that "the continued growth in the use of one of these glasses in London to date merely signifies the awakening public consciousness to a vital need, and thus the willingness to experiment." The users of ultra-violet transmitting glass should realize that in a large measure they are experimenting. The subject is too complicated and too uncertain as yet to be regarded in any other light.

Household Inventions



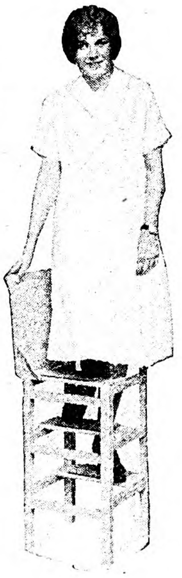
ELECTRIC "WIFE SAVER"

Arduous beating is eliminated with this handsome kitchen accessory. In addition to beating eggs, mixing batter for cakes, waffles, or omelets, the electric mixer is useful for scouring dirty utensils. It is claimed that the device extracts the juice from half a dozen oranges per minute.—*Speed-Way, 1834 S. 52nd Avenue, Chicago, Ill.*



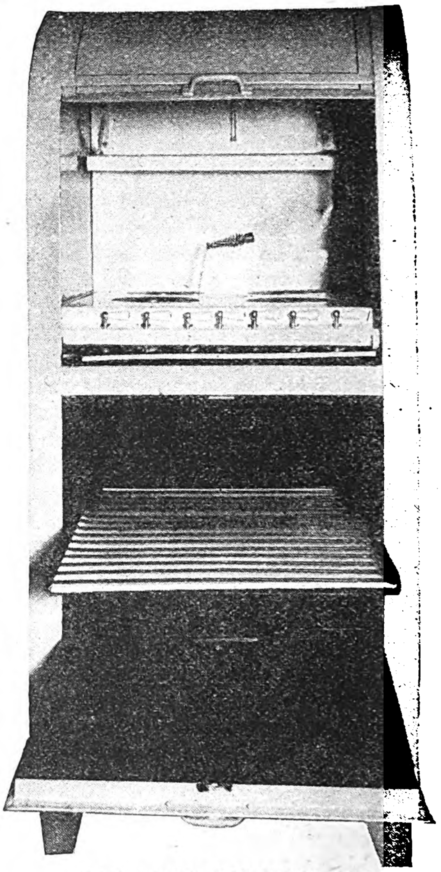
STOOL-LADDER

Combining two important uses in one, this neat little stool can be opened to provide a rigid step-ladder. Rubber treads cover the steps, and the stool is just the proper height for use near the sink or beside the table in the kitchen.—*Dillingham Manufacturing Company Sheboygan, Wisconsin*



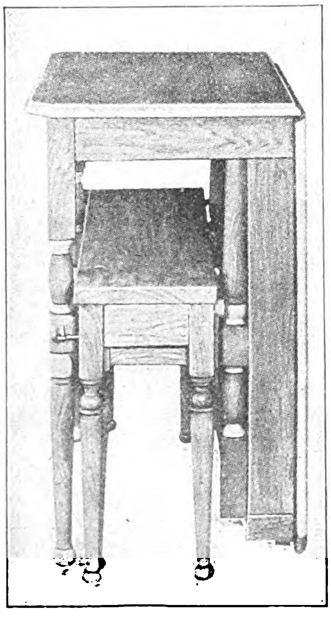
TANDEM TOASTER

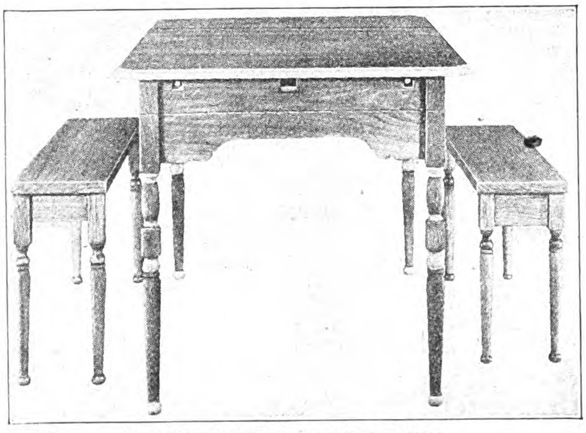
This product of the Edison laboratories toasts two slices of bread at once, and opens automatically when the toast is ready to be removed. —*Thomas A. Edison, Inc., West Orange, New Jersey*



GAS COOKING CABINET

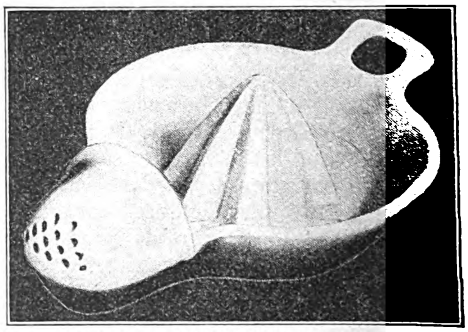
Something new in kitchen stoves is offered by the manufacturer of this gas "cooking cabinet." It is built of pressed steel, is insulated with asbestos and air, and has an oven equipped with an adjustable grid that slides in and out on ball bearings or moves up and down with a little crank. It is finished in white or in colors, and no pipes are visible.—*Pressed Steel Stove Company, 250 W. 57th Street, New York*





APARTMENT SPACE SAVER

Between meals this table serves as a flower stand or a reading table, but at meal time it becomes a regular dining room table seating six people with comfort. The benches are brought from beneath, and the extension put in place.—*Miller Frank Table Company, 228 N. La Salle St., Chicago, Ill.*

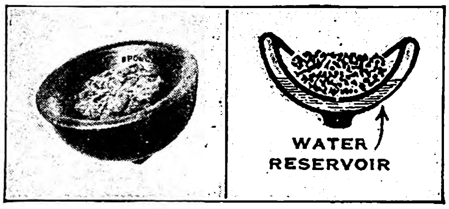


FRUIT JUICE STRAINER

The old fashioned fruit juice extractor has been improved immeasureably by adding a strainer of the proper size to fit into an ordinary glass. The juice extracted from oranges or other fruit can be poured directly into the glass, without the seeds or other waste. The device is made of hard white china.—*Corns China Company, Wellsville, Ohio*

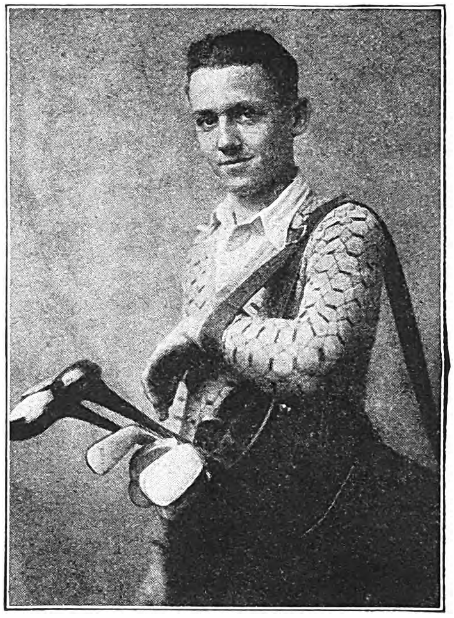
Accessories for the Golf Player

TO those of us who, by choice or otherwise, spend the winter in the cooler climates where winter golf is the exception rather than the rule, the slowly passing days of late winter bring with them wistful visions of rolling fairways and smooth velvety greens. Then out come the clubs for cleaning and polishing and the time is at hand to take stock of the accessories. What have the past few months contributed to the art of golf? you ask yourself. And at least part of the answer is presented on this page where we show a few of the "gadgets" that are now available for the golf enthusiast. May they help you to improve your game this season.



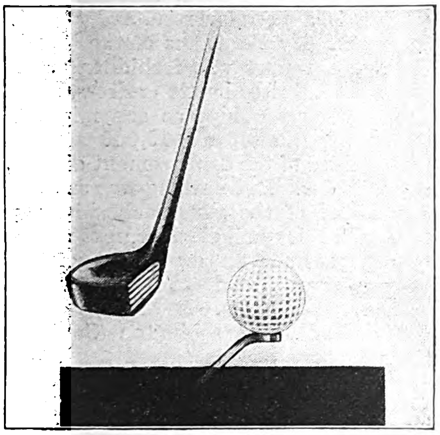
BALL CLEANER

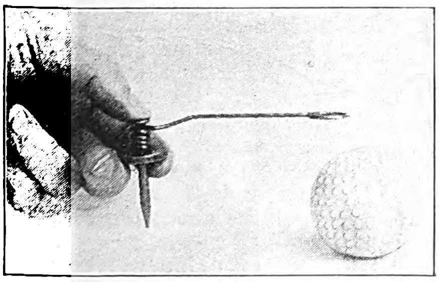
Rub the ball against the sponge in this cleaner and water from the reservoir cleans it. Can be carried safely in bag or pocket.—*St. Helens Cable and Rubber Co. Ltd., Slough, England.*

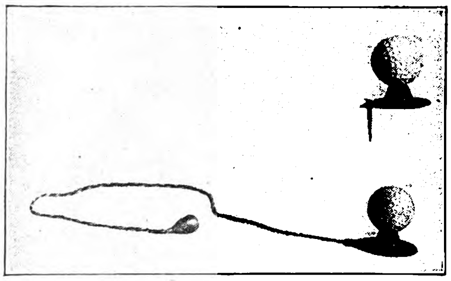


ARM SUPPORT ➤

A sling on the carrying strap provides an arm rest for the caddie or for the player. This support is more comfortable than resting arm on clubs. *Atlantic Products Corp., Trenton, N.J.*

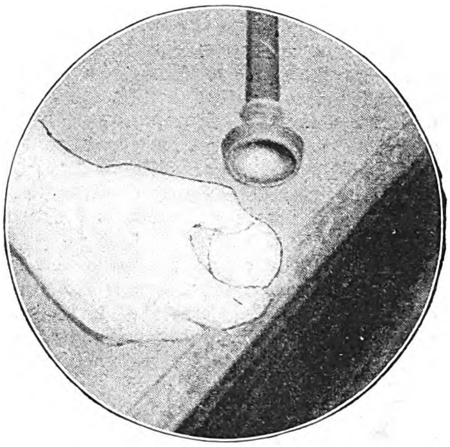






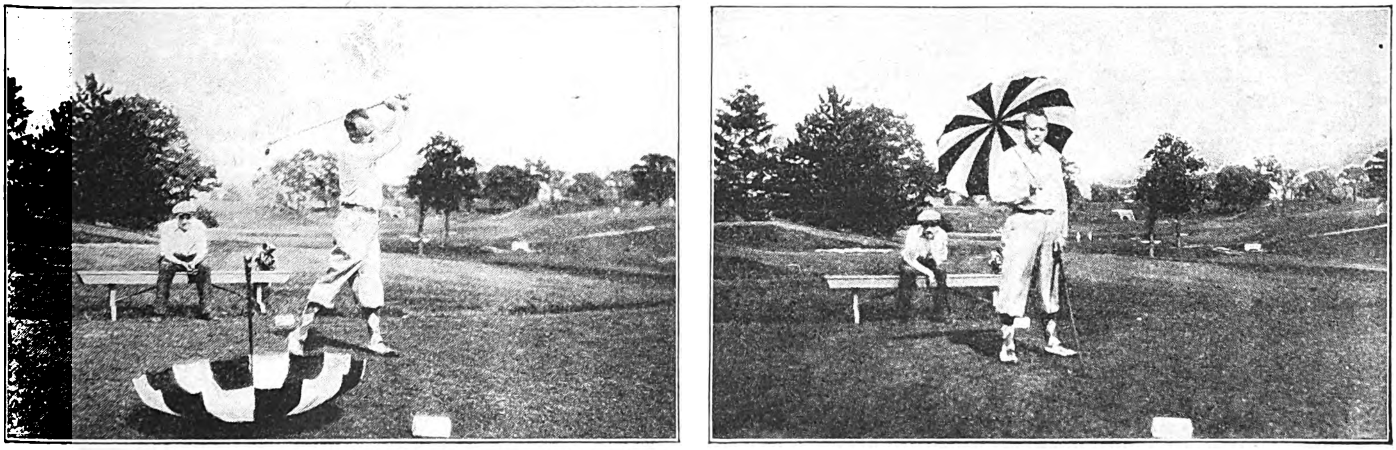
TEES, TEES, TEES

We illustrate three new types of tees. One at left, made by *The Angle-Tee Co., 207 Meriam Bldg., Cleveland, Ohio,* is forced into the ground at an angle and is said to offer little resistance to follow-through. Left below, made by the *Carter Golf Tee Mfg. Co., Anderson, Ind.* In this one, an arm swings around a pivot. The ball rests on a loop at the end of the arm. The third one, put out by *Perfect Golf Tee Co., New London, Wis.,* is made of rubber and comes in two styles, one to be pegged to the ground and the other equipped with a weighted string to prevent losing it.



BALL RETRIEVER

With this soft rubber cup fitted on the end of the putter shaft, balls can be lifted from the cup without stooping. When pressed over the ball, it holds it firmly. Especially useful for women.—*Abercrombie and Fitch Co., Madison Ave. and 45th St., N. Y. C.*



UMBRELLA FOR GOLF PLAYERS

Even on golf courses it rains and one can get wet before reaching shelter. Therefore, this umbrella designed especially for golfers should prove of use on many occasions. It is said to be extremely flexible and have a wide spread with a short handle. Its shallow depth lessens wind resistance. May be carried conveniently in the golf bag with the clubs. Also handy as a sunshade when the sun is strong.—*The Golf Umbrella Co., 115 Batavia St., Toledo, Ohio*

The Scientific American Digest

A Review of the Newest Developments in Science, Industry, and Engineering

Filling Station for Pocket Lighters

THE pocket lighter, that little gadget which replaces matches and supplies a light for the cigar by a simple flip of the thumb—sometimes—has become so popular in this country that many varieties of cigar-stand filling stations have been devised. A very attractive one recently announced by the Van Lansing Company of Appleton, Wisconsin, is modeled on the lines of its big brother of the automobile filling station. The lighter "gas" customer places his opened lighter under a nozzle, drops a coin in a slot, and receives one full charge of "gas." The operation is entirely automatic.

Houston's Arc-Welded Hangars

THE city of Houston, Texas, has recently erected three large hangars at its airport for the convenience of its flying guests. The hangars are of the all-metal type, corrugated iron sheeting being used to cover the arc-welded steel superstructure, rendering the hangars absolutely fireproof.

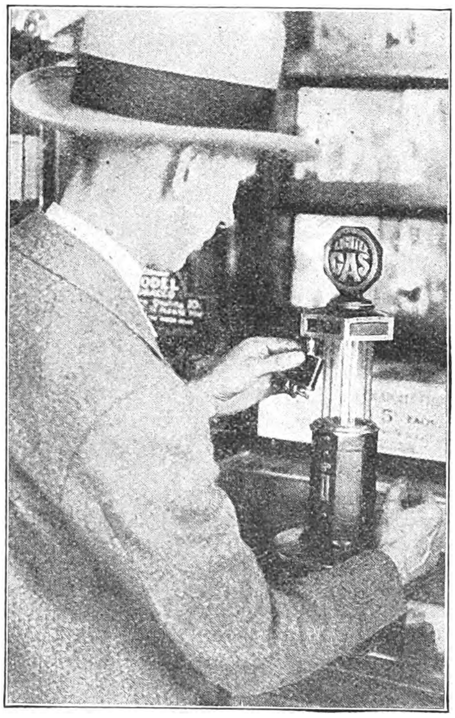
The greater rigidity and strength of this type of construction coupled with its low cost were the deciding factors.

Although these hangars were the first to be built employing the new method of construction, ample proof of the greater rigidity and strength of arc-welded steel fabrication was offered the owners, in the large commercial and industrial buildings which have been erected in various parts of the country, the steel framework of which has been entirely arc welded.

Each of the three hangars is 75 feet wide, 125 feet long, and approximately 50 feet high. The arches are made up from channel sections cut to form the arch when butted end-to-end and welded together. The entire fabrication of the arches was completed on the ground, an arch being raised into position and held in place by the welding of the channel purlins to the arches. The columns at the closed end are also channel sections. The framework of the monitors are composed of angles and channels. The steel sash in the sides and end wall were arc welded in place; in fact there are no bolts or rivets in the framework of the three hangars.

All the fabricating work on the three hangars was done in the field, all connections being made by the electric arc-welding process. Two portable gas engine driven Lincoln "Stable-Arc" welders were used to supply the welding current.

The simplicity of the novel design due to the elimination of all trusses and other forms of roof bracing is an economic factor which should favor arc-welded steel construction for future hangars. Another advantage of this design, due to its clear ceiling, is its practicability for hangars for blimps and similar lighter-than-air craft.



A coin in the slot delivers just enough "gas" to the pocket lighter

New German Cruisers are "Surprise Ships"

A NEW angle to the international cruiser question has been suddenly introduced by the disclosure of details concerning a new type of German fighting ship now building, which have just become known here. The *Ersatz Preussen*, first of a group of four to be built, represents enormously more hitting power than has ever been crowded into a 10,000 ton ship by the naval architects of any other nation. It is not unlikely that a complete revision of the specifications of the 10,000 ton "treaty cruiser" type will have to be made in answer to this latest stroke of the German Admiralty.

The *Ersatz Preussen* will carry as her main battery six 11-inch guns in two three-gun turrets, supplemented by eight 5.9-inch guns to repel torpedo attacks and four 3.4-inch anti-aircraft guns. She also carries six 19.7-inch torpedo tubes on two triple mounts.

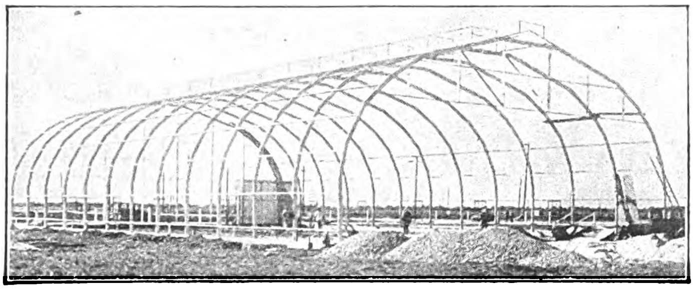
The appearance of a ship carrying guns as heavy as 11-inch, in a class where the conventional armament has been 8-inch or less, is a peculiar result of treaty restrictions. By the terms of the Versailles Treaty, Germany was forbidden to build any battleships or battle cruisers, and the size of such warships as she might construct was limited to 10,000 tons—less than a third of the displacement of modern capital ships. But nothing was said about the caliber of the guns such ships might mount. Their small displacement would, of course, preclude an armament of 14- or 16-inch pieces, such as post-war super-dreadnaughts carry.

Then, at the Washington Conference, the signatory powers agreed not to build any cruisers of more than 10,000 tons. They limited themselves also to guns of 8-inch caliber. These restrictions will remain in force until 1931.

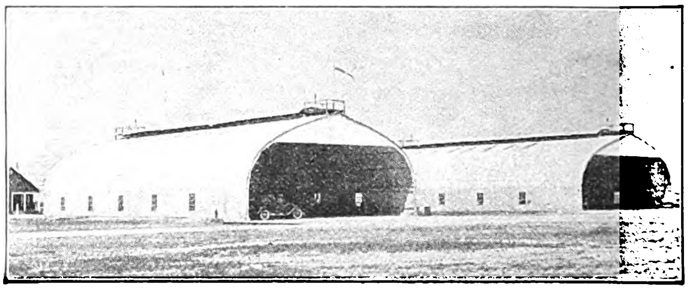
The typical post-conference cruiser, as built by Britain, Japan, and France, mounts eight eight-inch guns, although tentative plans for the American ships provided for in the 15-cruiser bill call for nine. By sacrificing armor, fuel, or machinery, enough weight might be gained to raise the battery to 10 eight-inch guns. But that would be about the limit for a 10,000 ton cruiser.

The new German ship will be able to throw from her six 11-inch guns a broadside totaling nearly 4000 pounds, for each 11-inch shell weighs 662 pounds. Eight eight-inch guns, with shells weighing 260 pounds apiece, could answer this with a broadside of not much over 2000 pounds, and a 10-gun cruiser would have only a 2600-pound broadside.

Thus, broadside for broadside, the German ships would have the post-conference cruisers out-gunned nearly two



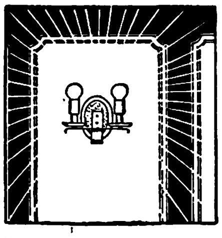
The completed arc-welded steel framework of one of the new hangars at Houston, Texas, ready for sheeting



Two of the completed hangars, each of which is 75 feet wide and 125 feet long. Note the wide entrances

Down like lead went display room costs because of this *grainless* wood

Here is a manufacturer whose sales shot up and whose costs went down when he paneled his showroom with Masonite Presdwood. Scores of others have used this sturdy material to solve a shipping problem, improve a product or cut production costs. You, too, may find, in some phase of your business, an ideal use for Presdwood. A generous free sample will be sent on request.


FOR LIGHTING FIXTURE DISPLAY PANELS

The problem of properly displaying their lighting fixtures was a "thorn in the flesh" with Victor S. Pearlman and Company of Chicago, until their architect, Bert C. Hubbard, recommended a showroom paneled in Masonite Presdwood.

Previously, fixtures were screwed to ordinary plastered walls. Changed displays left unsightly marks on the plaster. Screw holes had to be patched. And frequent redecorating was necessary.

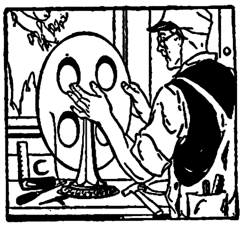
Now all the walls are paneled in Presdwood.

A different style of fixture is displayed in each section of the wall. The soft brown tone of the grainless wood panels harmonizes with the walnut finish of the rest of the room and sets off each fixture display to best sales advantage.

Presdwood saves decorating cost because it requires neither a rubbed or varnished finish. Although only one-eighth inch thick, this dense, sturdy material holds fixtures weighing up to forty-five pounds, even when ordinary wood screws are used. Old screw holes in Presdwood are easily filled. And when any section shows too many holes it can be removed and a new panel sawed out and put in its place at trivial expense.

Better products—Lower costs

But the uses of Presdwood are not confined to display room walls nor to any one industry, for in a multitude of manufactured products it is making things better while it makes them for less.


FOR RADIO SPEAKER TENSION BOARDS

It is used in radio cabinets, tension boards for loudspeakers, show cases, table tops, portable billiard tables, book cases, kitchen cabinets, china closets and for toys and playhouses.

It makes sturdy shipping boxes with ample strength to protect delicate articles. And it makes smooth boxes with no splintering surfaces to damage sheer silks or the finest fabrics. Because of its resistance to moisture, it is used for dairy product containers, for outdoor signs that are exposed to the weather and for side panels of motor truck bodies that must stand up under the hardest usage.

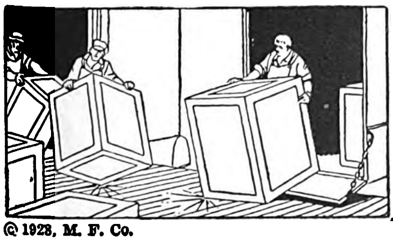
Liked by production men

Presdwood is easily worked, for it contains no foreign binding material to dull good tools. It is made in four foot by twelve foot boards, either one-eighth inch or three-sixteenths inch thick. It can be punched, die-cut, milled or sawed. And because it lends itself so readily to quantity production methods, it is becoming as popular with the factory production manager as with the sales executive who specifies it for display rooms.

Give Presdwood a trial. It may solve a display or production problem for you as it has for others. A large free sample is yours for the asking.

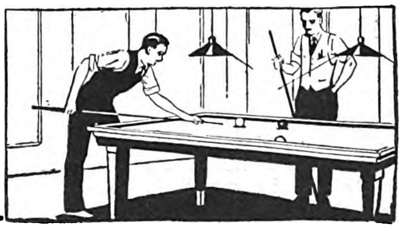
MASONITE CORPORATION
Sales Offices: Dept. 736, 111 W. Washington St.
Chicago, Illinois
Mills: Laurel, Mississippi

FOR STURDY BOXES

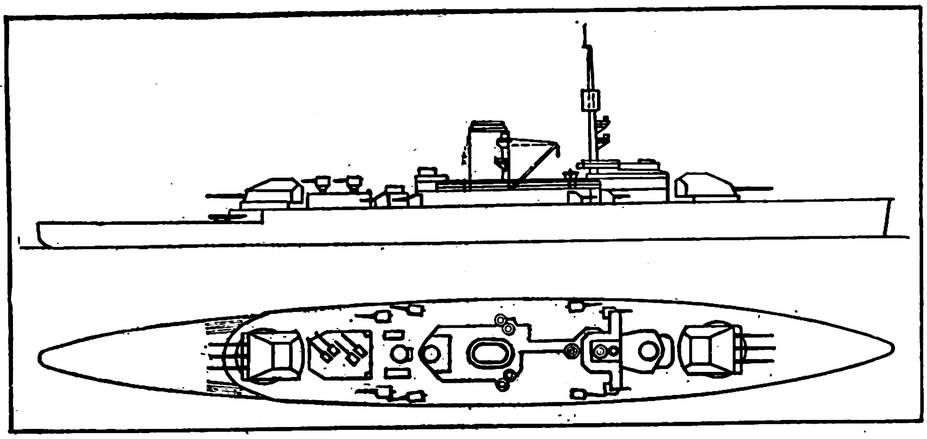


Masonite
PRESDWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

FOR PORTABLE BILLIARD TABLES



© 1928, M. F. Co.



Deck arrangement of the new German cruiser, from the side and from above. The 11-inch guns are in the forward and aft turrets; other guns as shown

to one. The eight-inch gun can be fired faster, thus cutting down the discrepancy somewhat; but against this must be balanced the long range of the German 11-inch gun, which is reported to have an extreme reach of 30,000 yards. The chances are that in an engagement between one ship of this new type and two post-conference cruisers, the German could hammer her opponents to pieces while they were endeavoring to close in to a range where their own eight-inch guns would be effective.

The engineering features of the *Ersatz Preussen* are said to be as remarkable as the power of her battery. Weight was saved wherever possible by the use of light-metal alloys and the highest grade steels. This effected an economy of some 550 tons, a saving of 5 percent on the capital of 10,000 tons displacement. The new ship will be driven by internal combustion engines of a new and radical type, developing a unit of horsepower for every 17½ pounds in weight, as against one horsepower for every 55 pounds in the best type of internal combustion marine engines now commonly known. Details of the new type of engine have not yet been made public.

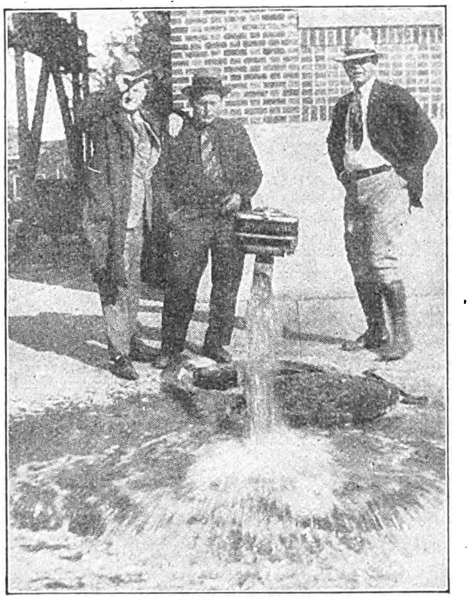
The speed of the *Ersatz Preussen* is to be 26 knots, and the German Admiralty states that she will carry enough fuel to make a continuous voyage of 10,000 miles at 20 knots. The most efficiently engined of present cruisers can travel that far, but only at the much lower speed of 13 knots. What the German ship could do at that speed is not known, but it has been estimated that she might cruise 18,000 miles or almost three-fourths of the circumference of the earth.

The naming of the new type of warship is presenting a puzzle. She is much too small to be called a battleship and too heavily gunned to be called a cruiser. The German Admiralty has called her simply an "armored ship," and let it go at that.—*Science Service.*

Drainage Pump Operated by Outboard Motor

A NEW type drainage pump which is powered with outboard motor and which is unique in that it is self-priming and will shut itself off whenever there is no water to be pumped, is now being manufactured by the Johnson Motor Company, builders of several types of outboard motors for boats.

This pump consists of a long pump shaft with a light twin cylinder outboard motor mounted on the top. The motor powers the impeller which is located at the bottom of the shaft. As the pump shaft sinks to the bottom of the water and the impeller is always submerged, no air can be sucked while there is still water to be pumped; thus delays in priming are eliminated. In addition, starting difficulties are also eliminated as the water begins to flow immediately after the motor is started. One of the most troublesome of pumping problems is thus eliminated.



Draining a manhole with the pump powered with an outboard motor

The automatic shut-off prevents the pump from burning out on the job. A workman can start it and can go away and forget it, for an ingenious safety device short circuits the magneto of the motor when water is not passing through the pump.

Contractors of all kinds, public utility companies and others have found uses for this pump on a wide variety of jobs. Some of these include pumping water from excavations, concrete forms, manholes, and barges. It is also found highly useful in dredging work of all kinds.

It will pump 195 gallons of water per minute and 1000 gallons for the approximate cost of one cent. It is claimed that it can do in five minutes what would require an hour and half for one man with a hand-operated pump, and with a half gallon of gasoline what another unit may do on a quarter of a ton of coal.

Where a truck might have been formerly used in transporting pump equipment from one job to another, this pump, weighing only 85 pounds, can be carried over the shoulder of a laborer. If long distances are involved it can be placed on the side of an ordinary automobile.

Setting Poles with Dynamite

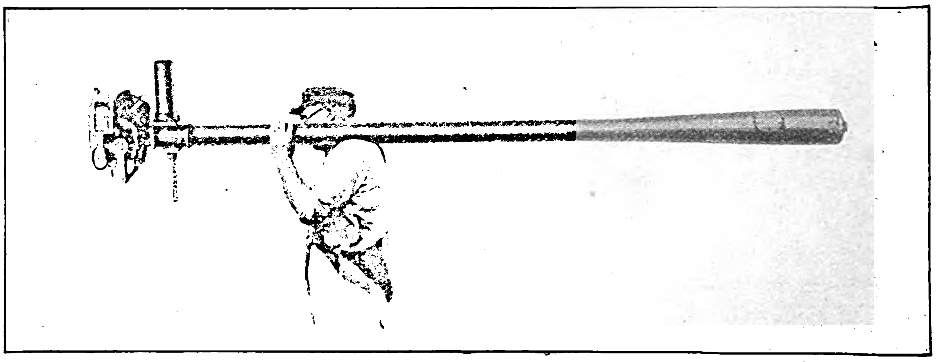
WHAT would you think if you happened along in time to see a line construction gang go through the silly act of standing a 50-foot pole on end on the surface of the ground and then saw the men stand back with rope guys and wait as if they expected someone to come along with a 100-pound hammer and drive the pole to its required depth? But how your curiosity would turn to awe when you felt a slight earth rumble and witnessed the pole slide gently into the ground to a depth of 10 or 12 feet.

This is an everyday occurrence in Florida. The method of setting power and telephone line poles with dynamite has been developed into an art, according to F. F. Johnson in the *O. B. Bulletin.*

The story goes that several years ago a laborer in a gang erecting poles in the soft soil of Florida, professed that he had been a "powder monkey" by trade and asked the foreman to give him a chance to blow a couple of holes in the soft ground and then see if they could not jam a pole into the hole before it caved. This method worked out fairly well except when the hole caved too soon or the pole when once down came popping out as though it had hit a powerful spring.

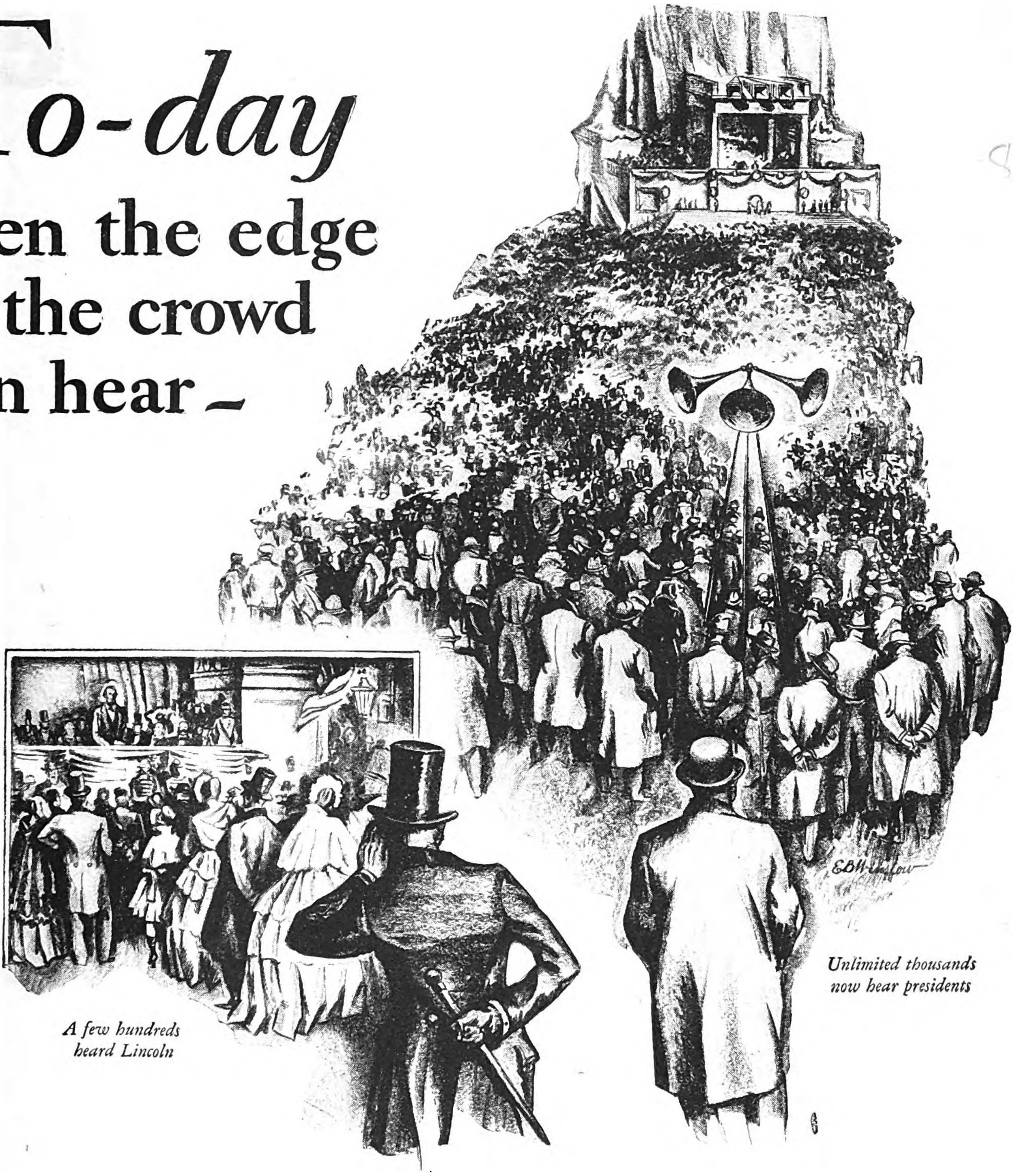
The foreman began to wonder just how high in the air a pole would go if stood on end over the powder hole before a blast. He let his curiosity get the better of his judgment and when the "joke shot" responded to the electrical current from the battery the pole did not go rocketing skyward, but instead, quivered once and then

(*Please turn to page 352*)



The outboard-motor-powered pump weighs only 85 pounds

To-day even the edge of the crowd can hear –



A few hundreds heard Lincoln

Unlimited thousands now hear presidents

AT present-day inaugurations of Presidents of the United States, everybody in the vast crowd assembled at Washington is able to hear every word of the ceremony. A Western Electric Public Address System, with its loud-speaking horns above the speaker's stand and at strategic points in the crowd, makes this possible.

This apparatus amplifies sound and distributes it to all parts of a city park or square or an indoor auditorium. In convention halls of hotels, it brings the speaker's voice loud and clear to people in the rear seats.

The Public Address System has a growing use in hotels, in amusement parks, in hospitals, where music or other entertainment can thereby be distributed from a single source to any number of places or rooms. The equipment is adapted to a wide range of requirements.. A product of the telephone art, the Public Address System is electricall and mechanically dependable. It is made by Western Electric and sold by Graybar Electric—two names that mean quality and service in things electrical.

Western Electric

PUBLIC ADDRESS SYSTEMS

Distributed by GRAYBAR *Electric Company*

Capt. George Fried,

"Reach for a Lucky instead of a sweet."

"AN S. O. S. from the 'Florida'! We change our course. We on the 'America' strain to arrive in time to rescue the men on their sinking ship, 350 miles away. Through the icy, freezing storm and high seas we plunge on—all speed ahead! Then the night-time rescue, the search lights, the whirling waves, the manoeuvering to get near the 'Florida.' Finally, the 'Florida's' crew coming off one at a time, pulling themselves through the water on the line our men had thrown them. These 32 men, dazed, many half clothed, needed reviving after their long exposure. Hot coffee, food and Lucky Strikes—these gave new life to many of them and we on board the 'America,' crew and passengers alike, found after the strain and struggle that there was nothing quite so comforting and relaxing as the inviting, toasted flavor of Lucky Strikes. Playing this game with 'Davy' is ever fascinating, ever thrilling. And we who follow the sea must be ever ready for adventure. Ours is an active life, demanding nerve control and physical fitness. In my health program I have found that Luckies are most important not only because they provide a respite for frazzled nerves and an exhausted body but because whenever I crave anything which is over-fattening, I say to myself, 'Reach for a Lucky instead of a sweet.' In the toasted flavor of Luckies, I get complete satisfaction. And I find that toasting, by removing the irritants, protects my throat."

Geo. Fried

George Fried
Commander of "*S. S. America*"

"REACH FOR A LUCKY INSTEAD OF A SWEET."

© 1929. The American Tobacco Co., Manufacturers

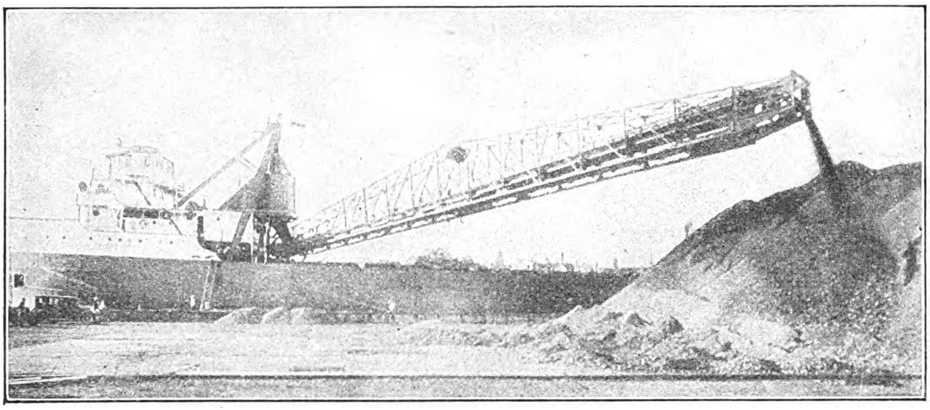
"It's toasted"

No Throat Irritation-No Cough.

settled into the ground without the flying of dirt as from the previous blasts.

With this start, a study of the use of explosives in pole erection has led up to its present state of efficiency in soil conditions comparable to those in Florida.

The Florida Power and Light Company uses the method for swamp land. At the pole location, a one and one half inch pipe is worked into the ground by the use of a one half inch rod for a plunger inside the pipe. With this agitation at the point of piercing, the pipe is easily pushed downward by the weight of two men applied on Stilson wrenches at opposite sides of the pipe. The pipe is forced to a depth representing the depth desired to set the pole, the plunger rod is removed, and several sticks of dynamite are dropped into the pipe and pushed to the bottom. The inertia of the pole at the instant of explosion tends to prevent an upward movement and what little ground disturbance takes place is seen around the pole. As the pole slides into place, gases from the shot leak out between the soil and the circumference of the pole. This pressure would indicate that the confined gases tend to retain the pocket walls awaiting the pole.—*Power.*



Unloading a cargo from the lake steamer that carries its own unloading equipment. A conveyor belt carries coal, gravel, et cetera, far out on the dock

Lake Steamer Carries Own Unloading Equipment

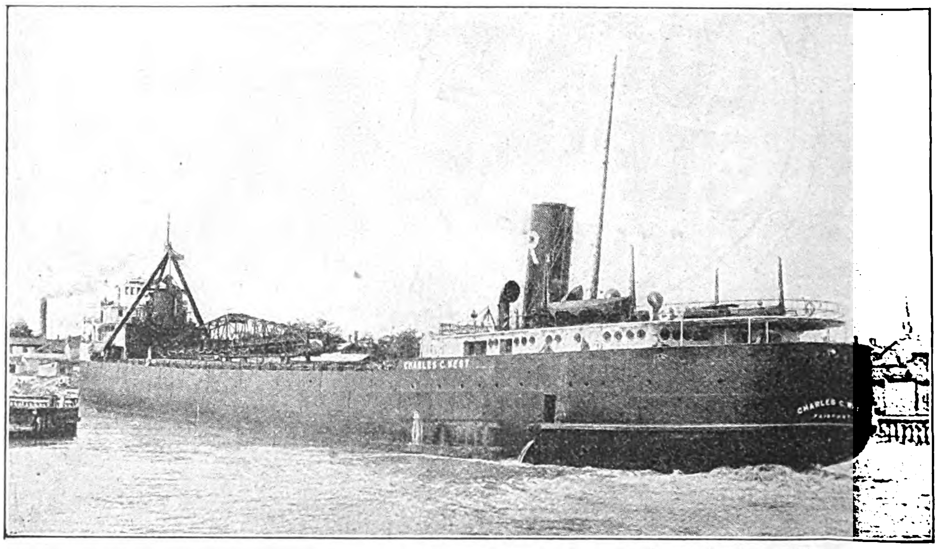
SPEED in the handling of bulky materials is at present the one big cry of industry. Get material on cars or in the hold of a vessel in a hurry; get it to the consumer in a hurry; and get it off the cars or out of the hold of the ship in a hurry. To answer this urgent trend a Great Lakes vessel has been equipped with special unloading machinery which is ready for service the minute the dock is reached and, because of this, no time is lost in getting the cargo unloaded and having the boat under way again for another trip.

The unloading machinery of this ship, the *Charles C. West*, was designed to operate with as little attention as possible. Steel compartments in the hold carry 8000 tons of bulk cargo. These bunkers are divided into two series on each side of the ship, and each series has 35 individual hoppers equipped with a gate operated by a power device. Under each series of bunkers runs a belt conveyor which carries the material to the forward end of the ship where it is fed onto another belt conveyor and then delivered to a bucket elevator.

This bucket elevator raises the material to a point above the decks where it is dumped into a hopper for feeding the great boom conveyor which is swung out over the side of the ship. The hopper gates of the cargo bunkers may be opened or closed by an operator, who uses a series of control levers so that the cargo may be kept in proper trim in shallow waters. The unloading capacity of this ship is 1800 tons of stone per hour.

The *Charles C. West* is 470 feet long, has a beam of 60 feet, and is 31 feet deep. It is designed to carry a full load with a much shallower draft than is usually the case, and is equipped with twin screws to give greater maneuverability in restricted channels and in ports where tugs are not available.

One of the biggest advantages of such a self-discharging ship is that she can unload at any dock not equipped with discharging machinery.



The lake steamer with its unloading equipment stowed on deck. When the conveyor boom swings out, material is fed to it by bucket elevators on the ship

Joining Glass to Metal by Soldering

THE sealing of joints between glass and a metal, such as brass, by soldering, is a convenient way of overcoming the difficulty usually experienced in hermetically sealing such joints. The method consists of plating the glass with a metal, such as silver, after which soldering may be accomplished in much the usual manner.

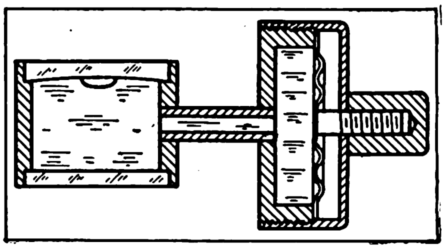
One application of this sealing process is shown in the accompanying illustration, which is a diagram of a spherical or universal level vial with bubble size control such as is used in certain aircraft instruments where the size of the bubble will be affected by changes in altitude.

As the bubble is composed of a globule of vapor which behaves in the characteristic manner when its surrounding pressure is changed, it is necessary to provide such a level vial with an adjustable expansion chamber so that, as the bubble expands when the ship rises, more liquid may be forced into the vial by depressing the reservoir diaphragm.

The liquid in the vial must be of low viscosity at any temperature likely to be encountered, and a solution of alcohol and water is frequently used. The thinness of this liquid and its solvent properties render it difficult to seal off properly, particularly where it is to be subjected to changes in pressure, as it will then penetrate unbelievably small openings.

A characteristic level assembly is shown in the illustration, which provides for bottom illumination of the bubble. It consists of a curved lens of glass sealed into a metal case which is connected by a tube to a reservoir, the top of which is formed of a corrugated metal diaphragm, movable inwardly or outwardly by a thumb-screw, this action forcing in or withdrawing liquid from the level case, altering the size of the bubble. All joints being of metal, except those between the lens and the case, they may be readily sealed by soldering.

In the first experiments with this instrument, a variety of sealing devices and cements were tried with indifferent success. Pressure joints could not be made tight enough and cements or plastic fillers were attacked by the liquid. Finally it was decided to coat the glass with a metal and solder this joint in the same manner as the others.



Spherical level vial in which the lens was joined to the metal by soldering as explained herewith

Metallic tin was sprayed on the edge of the glass lens with a metal spray gun and this tin adhered very firmly to the

NEW AUTOMATIC PERSONAL SERVICE MACHINES THAT TELL PRIVATELY YOUR WEIGHT AND FORTUNE FOR A PENNY....

With pardonable pride we announce the crowning achievement of twenty years of concentration on the problem of making a penny actuated personal weighing scale of real accuracy, that would give the weight and fortune printed on a convenient ticket and embodying all features necessary to long uninterrupted accurate service to the public. It is the new International Ticket Scale, and truly, "Nothing of its kind is so fine."

Soon you will see it everywhere, in drug, cigar and other stores, in waiting rooms, and on platforms of transportation lines, in amusement parks, in theatres, and in those thousands of other places where you can conveniently use them.

ACCURATE WEIGHT OR YOUR MONEY BACK

The new International Ticket Scale embodies dozens of advanced improvements, probably the first of which is the fact that the scale is so constructed that if it cannot give your accurate weight printed on the ticket, it will return your penny.

INTERNATIONAL IS CARE-FREE

The sign "Out of order" will seldom appear on International Scales. Children jumping on their platforms will do them no harm, thanks to an ingenious shock absorbing device. Inclement weather cannot damage them. The supply of tickets will rarely be exhausted because the scale holds 10,000 tickets which may be added to at any time. But for those rare occasions when something does go wrong, a national service organization with service men in every town of importance in the United States, is ready to put the International Scale in perfect shape within twenty-four hours.

MANY PATENTED FEATURES

The essential improvements in the International Ticket Scale, including the ticket, "as distinctive in design as the scale itself," the printing mechanism, the self-inking ribbon, the balanced platform, the shock absorbers, to name just a few, are exclusive with International, and fully covered by strong patents.

NATIONAL ADVERTISING

The patronage which International Scales will win for themselves will be maintained by aggressive consumer advertising in a campaign embracing the major consumer advertising mediums.

●

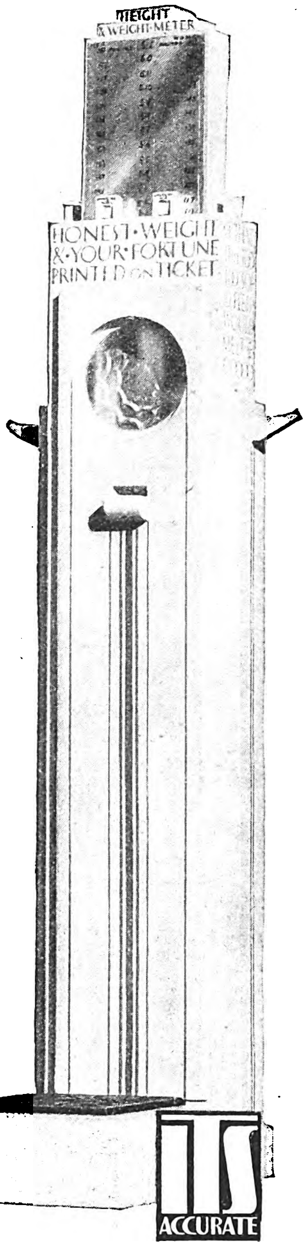
A BUSINESS OPPORTUNITY

THE NEW INTERNATIONAL TICKET SCALE

A private personal weighing service

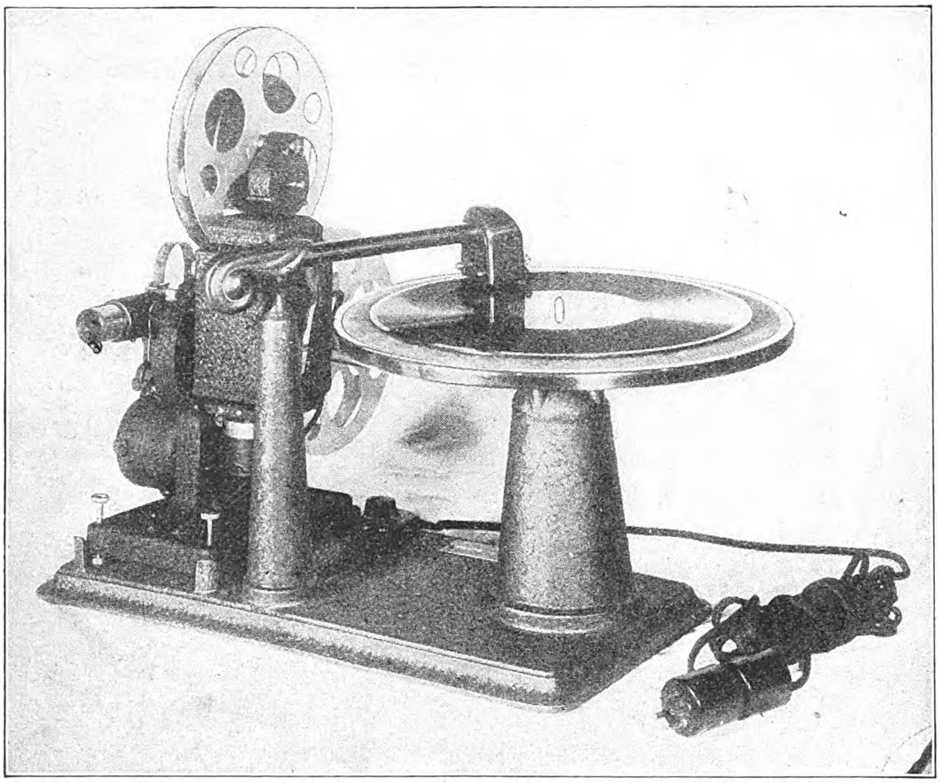
Exclusive territorial franchise for the purchase and operation of chains of International Ticket Scales are now being negotiated. Your first opportunity to enter an outstandingly successful division of the Automatic Merchandising Field...

●


WEIGHT & WEIGHT-METER
HONEST-WEIGHT & YOUR-FORTUNE PRINTED ON TICKET
ITS ACCURATE

Did you weigh yourself today? Perhaps you did not, but literally millions of people did. Tons of pennies are dropped into the familiar penny scales in drug and other stores each day. ● Now comes a new and better scale that prints the weight and fortune on a ticket. It gives a private personal weighing service. It is the product of twenty years of experience in the manufacture and operation of penny actuated scales. ● Its slogan is "Nothing of its kind is so fine," and we might add, so profitable. In appearance the finest and most distinctive of scales. The scale and printing mechanisms are built on time-tried and approved principles refined, perfected and simplified for faster, more positive operation and greater accuracy. If you owned a chain of these scales working for you day and night, you would have a steady sure source of income, unaffected by economic changes, by poor business, or by other unfavorable factors. Each scale need be seen infrequently. You would have a business practically without overhead, with no credit problem, with no administration expense, and with the minimum of working personnel. ● The first to place International Scales on location will reap an unusually rich harvest. Those now in a position financially to secure exclusive franchises for important cities, will look at the future with eyes that are unafraid. The earnings in this business, as high as 47% annually on the investment, will also attract those with a few thousand dollars, who desire the maximum return from their investment, and who are willing to devote a small amount of their own time to their care. ● Full details concerning all phases of the operation of chains of International Ticket Scales, are given in a booklet which we will be glad to send on request to any financially responsible person. Simply write Dept. 108; International Ticket Scale Corp., 17 East 45th St., New York, N. Y.

International TICKET SCALE CORPORATION
17 EAST FORTY-FIFTH STREET, NEW YORK, N. Y.



A new set-up for the amateur "movie" enthusiast: a "talkie" phonograph record synchronized with the picture film as it is run through the projector

glass. The lens was then easily soldered into the case with ordinary tin solder.

Another method which has since been used is to coat the edge of the glass with silver, making use of any of the mirror silvering processes. The silver is deposited tightly on the glass if the work is properly performed and the joint may readily be made liquid proof. The writer has also joined glass to metal by first plating the glass with platinum, the process consisting of wetting the glass with a solution of platinum chloride and heating in an open flame, which drives off the water and chlorine, leaving a mirror-like deposit of metallic platinum. In all cases the deposit of tin, silver, or platinum is so firmly attached to the glass that joints as described above may readily be hermetically sealed.

Conquering Pulpwood Fires

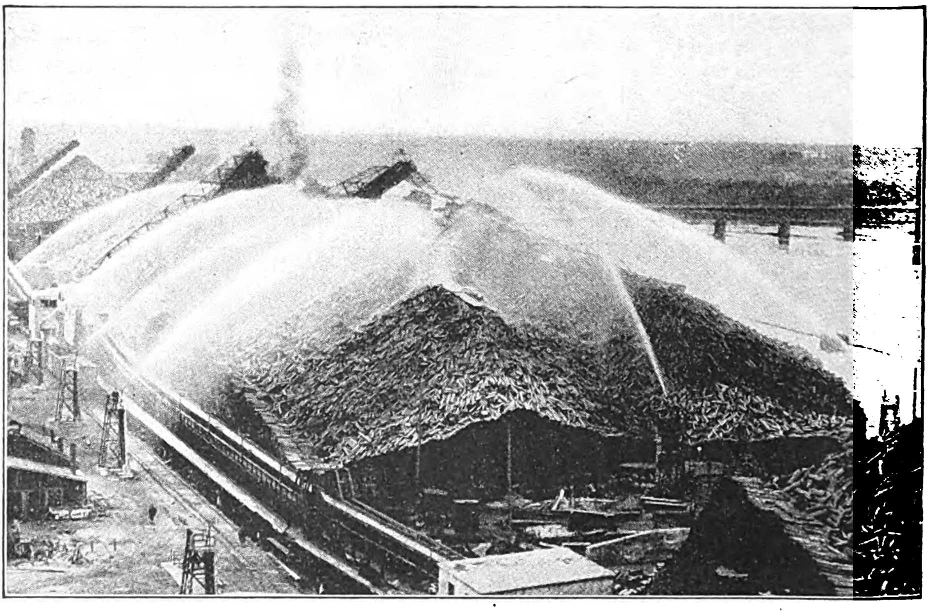
MONITOR nozzles are a recent development in fire protection as applied to the huge piles of pulpwood logs held in outdoor storage at paper mills. Distributed at frequent intervals around the edges of each pyramid of timbers, the nozzles afford a means of flooding a fire with water the instant the outbreak is discovered.

The new form of equipment is superseding portable hose lines which had to be dragged into position and coupled to fire plugs with serious loss of time. The monitor nozzle is always ready for use. Located in a fixed position, on the ground or on a tower, and connected with high-pressure water mains, the nozzle may be placed in action within 60 seconds. When a stream is turned on, the water has a flow of a thousand gallons a minute. Each nozzle is adjustable as to slant and direction. If a second stream proves necessary it can be started from another nozzle. The whole process is completed in less time than would be required for a watchman to summon aid and drag a hose line to a hydrant.

When ordinary fire hose is used, the fighting of fire in a pulpwood pile is a difficult proposition. The loosely piled logs prevent firemen from scaling the sides of the pyramid, and the streams must be directed from the ground. In the case of a fire near the summit of the pile the water does not reach the blaze, because of the height of the mass and the sloping sides. A single pyramid is likely to cover a full acre of ground and reach 80 feet or more into the air. The contents may be as much as 20,000 cords of wood, valued at 300,000 dollars.

The air-dried surface of a pulpwood pile is easily set on fire by a spark. When the blaze is once started it is carried into the heart of the pile through the agency of embers dropping through crevices between the loose logs. Water thrown on the surface is shed from the sloping sides and little of the flood reaches the internal flames. In this situation the fire eats more and more deeply into the mass, causing total loss. Paper makers feel that the fire which gets a good start before water is applied presents a hopeless task for the fire fighters.

The quick action permitted by the monitor nozzles enables one man to fight such a fire more effectively than a small army equipped with hose, since the one-man fire brigade does not lose time in waiting for other workers to answer his alarm. His nozzle is at work before assistance could reach him. Various incipient pulpwood fires have been stopped by the new installations.



Huge piles of pulp wood such as this, at paper mills, often ignite spontaneously. Fires may be quickly controlled by means of the tower nozzles

"Talkies" in the Home

IT is now possible for the amateur motion picture enthusiast to have talking motion pictures in the home, just like those he sees in the theater. The De Vry Corporation of Chicago, Illinois, recently announced that they are ready to supply the public with a standard 16-millimeter motion picture projector geared to a phonograph record turn-table equipped with an arm and electric pick-up. From the latter, the modulated electrical currents are fed through a radio amplifier to a loud speaker. The fact that the turn-table and motion picture projector are geared to the same shaft forces absolute synchronism of sound and picture.

Since it is quite obvious that an installation of this type would be useless without further co-ordination between motion picture and sound record production, the company that puts out the apparatus has a library of films and their accompanying records which will be issued monthly so that there will be a constant supply of new entertainment.

Writing Japanese with Roman Alphabet

THE use of Roman characters in Japanese writing has been criticized and defended for a sufficient number of years to

(*Please turn to page* 376)

The Winged Hand will

Move—
Convey—
Store—

your materials more
Economically, Systematically,
Speedily and Safely
than any other system

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"The Material Handling Specialists"

for their free recommendations. There is a system, a method and a type best suited to your particular and specific needs. They will gladly tell you exactly what it is—how much it will save you and what you will accomplish by its use.

Don't buy merely a truck—buy the type size and style built specifically for the work you have.

The Stuebing Cowan Co.
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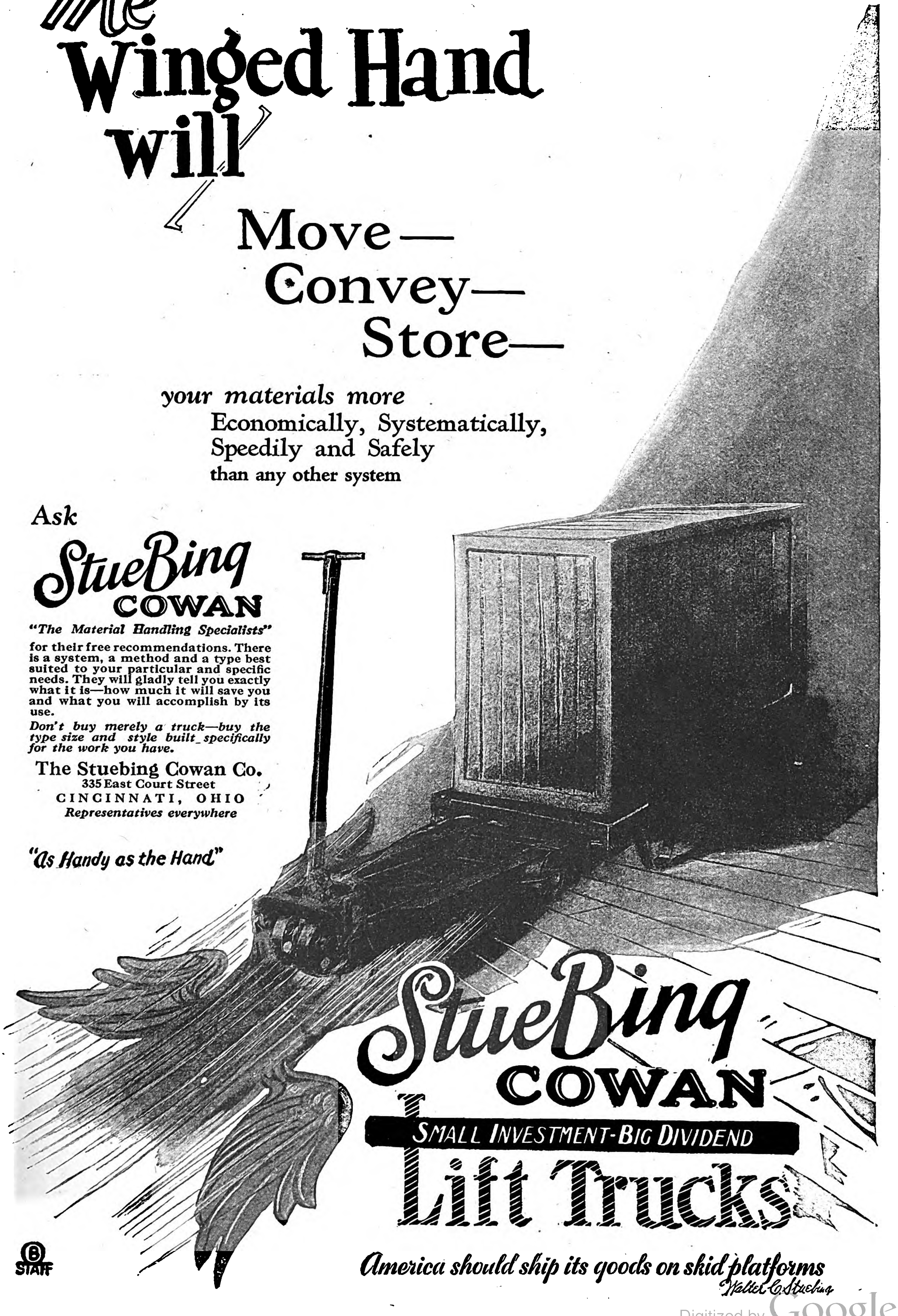
CINCINNATI, OHIO
Representatives everywhere

"As Handy as the Hand"



America should ship its goods on skid platforms
Walter C. Stuebing

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

Planes on the Instalment Plan

PLANES can now be bought on the instalment plan, similar to that customary in the automobile business. Commercial Credit Companies of Baltimore will finance the purchase of planes provided they are of approved commercial types, and are to be flown by transport pilots. The minimum cash payment required for a retail sale is 33⅓ percent, which is somewhat more than is necessary in the purchase of an automobile, and a complete line of insurance has to be obtained. Nevertheless the announcement of the Baltimore company is significant of the practical character which the airplane industry is now assuming.

Curtiss-Caproni

THE newspapers have recently carried announcements of the formation of a new, four million dollar corporation, the Curtiss-Caproni, which unites one of the foremost American companies with one of the best Italian constructors. Mr. C. M. Keys announced that by this union of talent and finances, the Curtiss company would save several years in the development of large commercial aircraft.

Certainly Caproni has built and flown successfully airplanes which are larger than any flying in the United States to-day. Caproni employs an all-metal structure, with fabric covering. His interior wing construction with built-up dural spars is not unlike the girders of a rigid airship. The Caproni *CA.79* is equipped with four engines of 500 horsepower each. It can carry a bomb load of 4400 pounds, has a span of 78.5 feet for the upper wing, 116 feet for the lower wing, a total wing area of 2360 square feet and a maximum speed of 129 miles per hour.

Of particular interest in this design is the fact that the lower wing is much longer than the upper one. It is difficult to say what the aerodynamic advantage of such an arrangement may be. There are two engines in tandem at the center and one engine on each side, mounted on the lower wing. The design differs radically in appearance from American practice.

Caproni shows an even larger monoplane, equipped with three 1000 horse power water-cooled engines. The photograph of the wind-tunnel model of this giant shows remarkably clean lines, and a very well worked out wing trussing. Finally, Caproni has in process of construction what is undoubtedly the largest plane in the world. This is designed for either military or commercial use, is equipped with six 1000 horsepower engines, and has a gross weight of 55,000 pounds. It will be interesting to see the construction of these huge craft in our country. They may be of real value in the air transport work of the future.

The Aircraft Diesel Engine

THE Packard Motor Car Company has recently tested successfully in flight an aircraft Diesel engine, seven cylinder air-cooled, developing over 200 horsepower and weighing only a little over three pounds per horsepower. The Diesel engine offers great advantages for aviation by its elimination of the ignition and carburetion systems and by making possible the use of heavy fuels, non-inflammable in character. The Packard tests show that the aircraft Diesel has passed from the phase of speculation to that of practical experimentation. It is therefore very interesting to read the paper submitted to the Society of Automotive Engineers by Captain L. M. Woolson, Research Engineer of the Packard Company.

We show the typical indicator diagrams of an ordinary gasoline engine, a low-speed Diesel engine, and a high-speed Diesel.

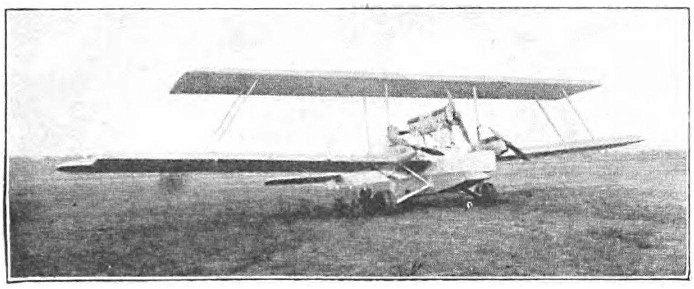
In the ordinary gasoline engine, the fuel enters the cylinder with the charge of air, the mixture is compressed, and is ignited by an electric spark at the end or a little before the end of the compression stroke. The explosion is very rapid, and the gas rises to its maximum pressure while its volume remains practically constant. It then does its work on the expansion stroke. The maximum pressure developed in the gasoline engine is of the order of 550 pounds per square inch.

In the stationary Diesel we find that low speeds of 200 or 300 revolutions per minute are generally used. In the low-speed Diesel, the air is compressed insi the cylinder just as in the gasoline engine, but solid fuel is injected about 10 degrees before the end of the compression stroke and the injection continues until about 32 degrees past top dead center. Generally, some form of hot bulb is used to secure combustion, and the maximum pressure is no greater than in the gasoline engine. Combustion takes place at constant pressure, as can be clearly seen from the diagram. The low-speed Diesel has a lower mean effective pressure than the gasoline engine, and this, coupled with its slow speed, makes it totally unsuitable for aircraft work—the weight of the power plant alone would prohibit its use.

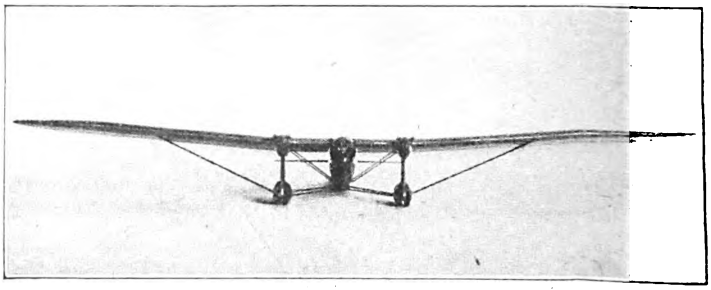
Therefore we are driven to the conclusion that an aircraft Diesel engine must be of the high-speed type, with revolutions per minute in excess of 1500. In the high-speed Diesel, to ensure complete and smokeless combustion, the injection of fuel must start early, about 50 degrees before dead center. The compression at the end of the compression stroke must be 500 pounds, or equal to the maximum pressure developed in the gasoline engine. There is no need of a spark or even of a hot bulb, the high pressures and temperatures producing auto-ignition. The maximum pressure rises to the enormous value of 1200 pounds per square inch. The compression ratio is 14 to 1, as compared with the compression ratio of 6 to 1 in the gasoline engine. The efficiency is accordingly much higher than in the gasoline engine.

Since higher efficiency is added to its other advantages, one would assume the aircraft Diesel to be absolutely the ideal power plant for all aircraft. There are, however, certain difficulties.

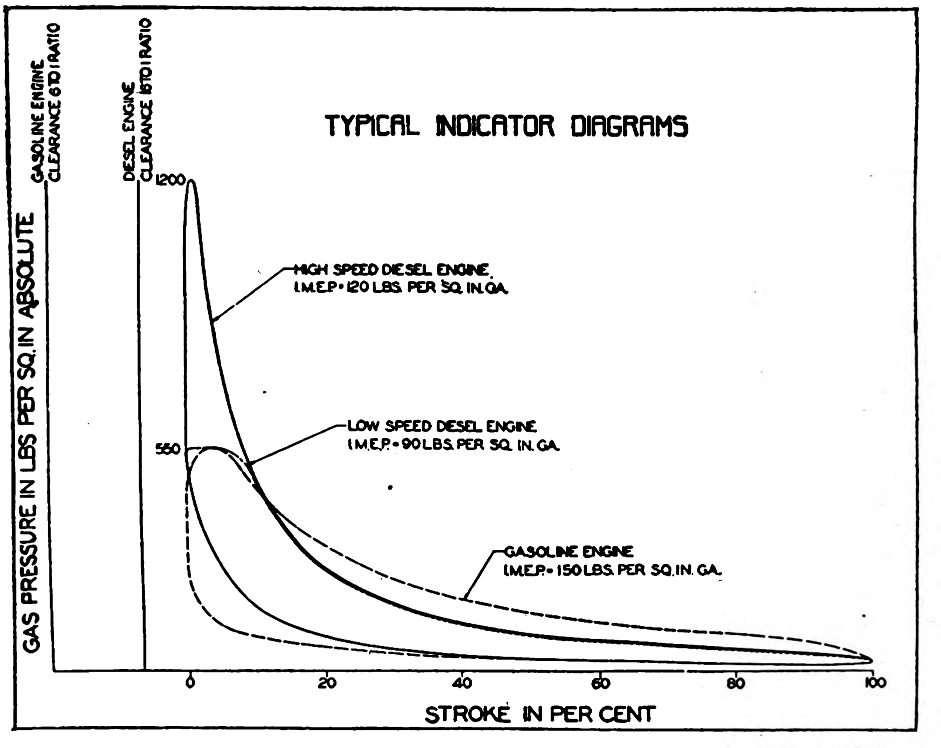
The gasoline aircraft engine has been greatly reduced in weight per horsepower, but it has to withstand a maximum pressure of only 500 pounds per square inch. How can the Diesel engine cylinder with its maximum pressure of 1200 pounds be kept within reasonable weight limits? The answer is that by careful design and the utilization of the best possible materials, the Packard aircraft Diesel weighs less than three pounds per horsepower. As a typical example of what the Packard engineers did, light cast alloys have been eliminated as unsuitable for meeting high al-



A four-engined, 2000 horsepower biplane designed by Caproni. Note the relative lengths of the two wings



A wind-tunnel model of a monoplane of Caproni design. The lines of this plane are exceptionally clean-cut



Typical indicator diagrams for an ordinary gasoline engine, a low-speed Diesel, and a high-speed Diesel. The text starting on page 356 describes these

ternating stresses. Captain Woolson does not state this in his paper, but more expensive machined parts in steel have probably taken the place of the castings.

Captain Woolson does not deal with the injection of fuel. An enormous amount of research has been done by several agencies on this problem. Suitable high-pressure pumps and the right kind of injection nozzles have already been developed.

The gain in simplicity by the use of the Diesel is shown by the following facts:—In the typical gasoline engine, there are two separate magnetos, 18 ignition wires, 18 spark plugs, and an ignition switch. There is an aggregate of perhaps 1000 individual parts making up the ignition system. In the Diesel, with its automatic ignition, no additional parts of any kind are required. Continuous ignition is assured just as long as the engine is operating. Furthermore, the ignition system of each Diesel engine cylinder is entirely independent of the ignition conditions in any other cylinder.

Now compare the fuel supply systems. The conventional nine-cylinder gasoline engine is dependent on perhaps a single carburetor—at best on a triple-barrel carburetor. Even with the triple carburetor, there are only three independent carburetion systems, the failure of any one of which will result in the loss of one third of the operating cylinders. In the Diesel, each cylinder receives fuel from an independent pump, thus making it impossible for a clogged fuel line to impair the performance of more than one cylinder.

Comparing fire hazards, we find that the fire point of gasoline is below zero, Fahrenheit; for the heavy fuel used in the Diesel it is 175 degrees, Fahrenheit. In the Packard tests, lasting over a year, there were innumerable cases where fuel lines leaked or were even broken off. Not a single fire resulted.

Heavy fuel oil is much cheaper than gasoline. With aviation gasoline at 19.8 cents per gallon, the cost is 1.7 cents per brake horsepower hour. With the Diesel engine, the corresponding cost is 0.35 cents per brake horsepower hour or about one fifth as much.

Another interesting point in the Diesel is the fact that it will operate successfully in any position. All engines using carburetors are dependent upon gravity as far as correct functioning of the carburetor is concerned. With the Diesel, worry as to position in a steep climb or in stunting is entirely eliminated.

We only hope that other aircraft engine manufacturers will energetically follow Packard's example and make the transition stage from gasoline to heavy fuel-oil as brief as possible.

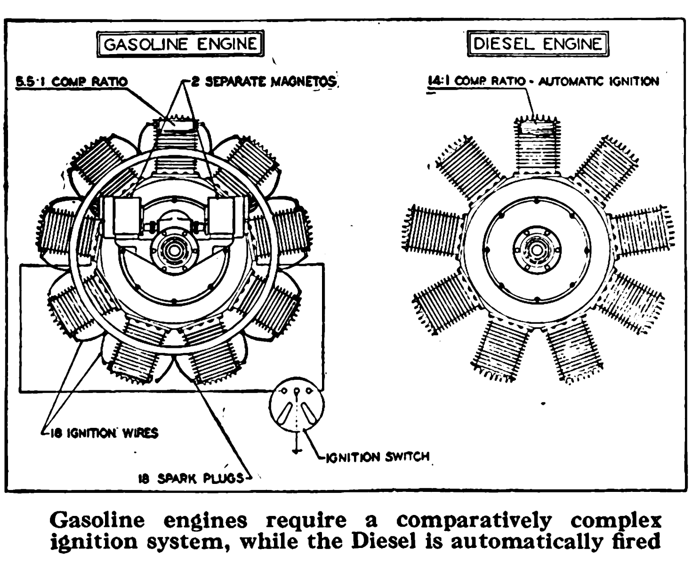
To Panama by Air

COLONEL CHARLES A. LINDBERGH has become technical adviser to Pan-American Airways and, by piloting a mail plane over the "Lindbergh trail" to the Panama Canal Zone, officially opened that route. This will be the fourth and longest route of the Pan-American Airways. The course is through Havana, British Honduras, Nicaragua, Costa Rica, and ends in Cristobal. In some cases as much as two weeks will be saved on South American mail. The trip from Miama, Florida, will be made in a twin-engined Sikorsky amphibian, which is undoubtedly one of the outstanding American planes of to-day.

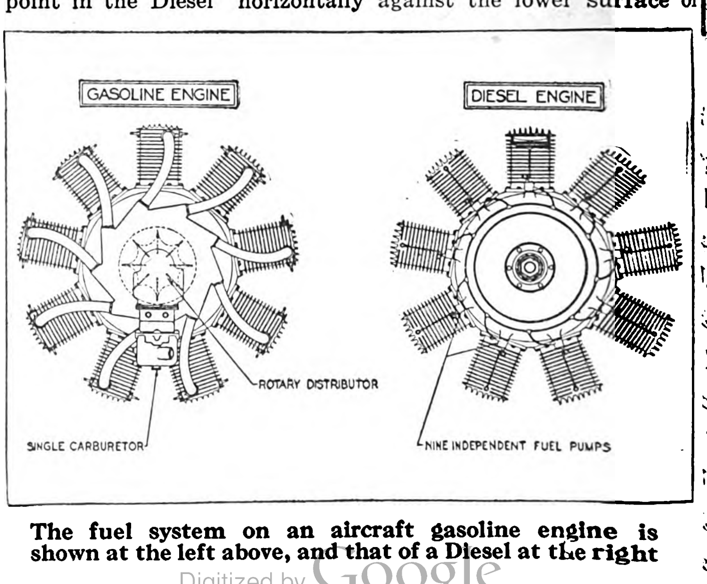
We are indebted to the Sikorsky company for the appended photographs and latest data.

The Sikorsky *S-38-B* is powered with two Pratt and Whitney Wasps, of 410 horsepower each. It can fly fully loaded, and even climb to some extent, with one of the engines out of commission. The weight empty is 6000 pounds. The useful load is 4000 pounds. With this load, the maximum speed is 124.5 miles per hour, and the initial climb 880 feet per minute. The useful load is distributed as follows: Crew (two), 340 pounds; equipment, 125 pounds; gas for five hours' flying (180 gallons), 1080 pounds; nine passengers, 1530 pounds; baggage and mail, 800 pounds. The total pay load is thus 2330 pounds. The total wing area is 720 square feet, and the maximum wing spread is 71 feet, eight inches.

By means of a simple, manually operated, hydraulic control, the landing wheels, separately or together, can be raised in 30 seconds, and lowered in 40 seconds. If the pressure in the landing gear oil-supply tank is kept at 25 pounds by the small hand pump installed as standard equipment, the landing gear is pushed down automatically. When retracted, the wheels lie horizontally against the lower surface of

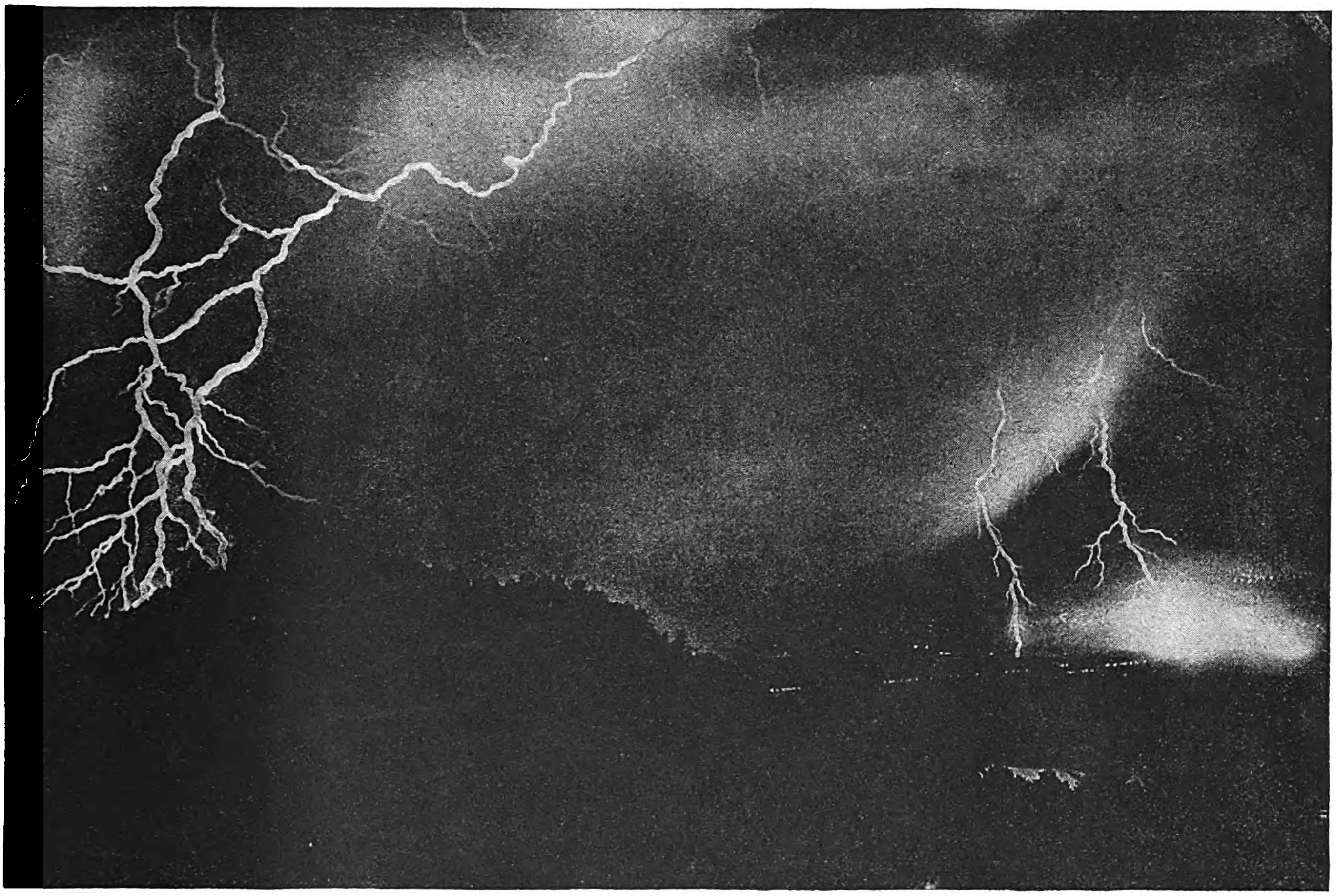


Gasoline engines require a comparatively complex ignition system, while the Diesel is automatically fired



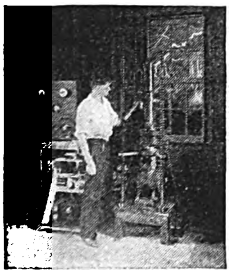
The fuel system on an aircraft gasoline engine is shown at the left above, and that of a Diesel at the right

WHAT WESTINGHOUSE IS DOING IN RESEARCH



WESTINGHOUSE ENGINEERS ARE STUDYING LIGHTNING IN ITS STRONGHOLD

Waging War Against Lightning



Lightning, the raider of power lines, each year exacts a heavy toll in lost time and damaged equipment. In the flick of an eyelash, or less, it stages its attack, vanishes, and leaves no trace except a trail of waste and ruin which must promptly be repaired to maintain standards of service.

Long ago Westinghouse declared war against this elusive plunderer when A. J. Wurts, a Westinghouse engineer, developed his famous lightning arrester.

Now science has placed in the hands of engineers new devices for repelling this invader.

Today, in the mountains of Tennessee, Westinghouse has established an outpost of engineers armed with amazing new machines swifter than lightning itself to gather records to serve as foundations for protective devices.

The new Norinder oscillograph catches the flash of any lightning stroke within its range. The smallest spark or the hundred-million-volt explosion leaves its autograph for experts to study and compare. Along with this device sensitive Osisos record line disturbances and indicate the position and magnitude of thunderbolts. Klydonographs record the shocks received by transmission lines. Every important detail is observed and reported.

Thus Westinghouse, pioneer in the development of practical methods of generating and transmitting alternating current, is now developing new ways to protect power transmission . . . a basic asset to the world of business and industry.

The Sign of a Westinghouse Dealer

Westinghouse Electrification
Appliance Apparatus
Wiring

Westinghouse

A DREAM

REALIZED

NEW YORK LIFE INSURANCE COMPANY

(INCORPORATED UNDER THE LAWS OF NEW YORK)

A MUTUAL ORGANIZATION, FOUNDED IN 1845

EIGHTY-FOURTH ANNUAL STATEMENT

TO THE POLICY-HOLDERS:

Our Eighty-fourth Annual Report has been verified and is being filed with various governmental authorities. May I point out to you, the people chiefly interested, some of its salient facts?

As policy-holders you paid the Company last year in round figures $256,000,000.

The Company paid to you and to beneficiaries $156,000,000.

That left us about $100,000,000.

Our net reserves increased during the year $100,000,000.

We put that $100,000,000 in our reserves.

You may ask, what are reserves?

Broadly speaking, they are funds set aside from which future liabilities are to be met.

We put that $100,000,000 in reserves at the close of the year for that specific purpose.

A policy of Life Insurance is almost exactly like a bond. It will mature some day. Nearly all bonds mature at a definite date. Most policies of Life Insurance mature at an indefinite date, but all will mature, in some form, within a limited period of years.

A sound bond is protected by a Sinking Fund—from which the bond is to be redeemed at maturity. The Sinking Fund is accumulated by yearly deposits.

That $100,000,000 was our 1928 deposit, our addition to the Sinking Fund for that year.

The law requires it. If we had failed to make or could not make that entry (deposit) we would soon be declared insolvent by the Insurance Departments and the Courts.

The reserve increase for 1928 was large, but no larger than the law requires.

That we shall redeem all our bonds (policies) as they come due is certain. You know that.

The other income of the Company was sufficient to pay all the expenses of acquiring $900,000,000 of new business in 1928, the care of about $6,500,000,000 of old business, taxes, $6,700,000, the care of invested funds, the maintenance of other legal reserves and a sum sufficient to pay in 1929 $8,000,000 more in dividends than we paid in 1928, and to increase the general surplus by $4,000,000.

Dividends to Policy-Holders in 1928 . $58,600,000

Dividends in 1929 67,100,000

BALANCE SHEET

ASSETS		LIABILITIES	
Real Estate Owned and First Mortgage Loans on Farms, Homes and Business Property......	$564,502,256.85	Reserves—ample with future premiums and Interest to pay all insurance and annuity obligations as they become due..........	$1,340,100,132.87
Bonds of the United States, Other Governments, States, Cities, Counties, Public Utilities, Railroads, etc....	641,944,719.68	Dividends Payable to Policyholders in 1929......	67,148,446.00
Preferred and Guaranteed Stocks	31,238,610.00	All other Liabilities......	7,973,047.98
Policy Loans, Cash and Other Assets...........	297,394,761.12	Total Liabilities.........	$1,415,221,626.85
		General Contingency Fund	119,858,720.80
Total Funds for Policyholders' Protection	$1,535,080,347.65	Total........	$1,535,080,347.65

In addition the Company loaned you on the sole security of your policies $52,700,000.

These are round figures, calculated to give you merely an outline sketch of the Company's activities in 1928.

SAVING YOUR MONEY

How much of the $156,000,000 we paid you or to beneficiaries during 1928 and how much of the $52,700,000 loaned you during that year will be lost because unwisely invested? That is a very important question. It goes to the very heart of the usefulness of Life Insurance. To save money by investing it soundly is difficult.

Even men of experience frequently make mistakes.

I do not overstate the truth when I say that few people having small amounts of money to invest do it wisely.

REMEMBER

You can leave the proceeds of your insurance with this Company in trust for your beneficiaries or you can leave any cash due under your policy and the Company will hold it, guaranteeing your principal and not less than 3% interest.

On all such funds we will pay in 1929 (as we have done for some years) 4.6%.

In 1928 you left with the Company in this way under various accounts $28,000,000.

Your total under these accounts on January 1, 1929, was $70,000,000.

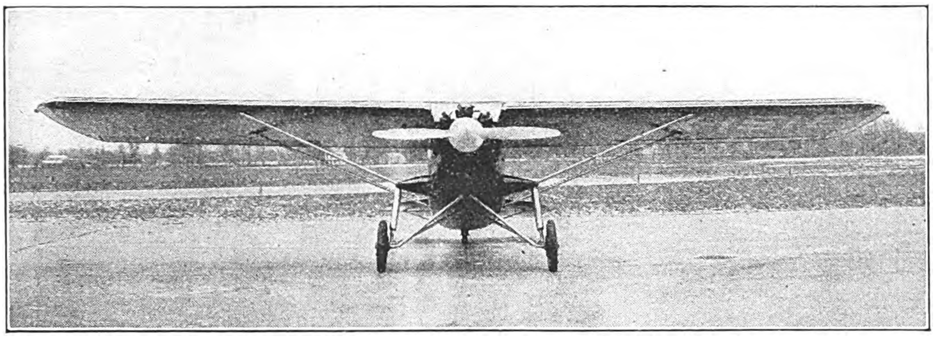
That $70,000,000 is not just a deposit. It is mingled with the Company's entire assets and is a part of the Company's liabilities. It is backed, as all our liabilities are, by $1,500,000,000.

Finally study the balance sheet. There you have the facts about our financial condition, while above you have a picture of the new Home Office: "A Dream Realized."

Show the "Dream" and the balance sheet to your neighbor.

New York Life Insurance Company

By DARWIN P. KINGSLEY, President



Front view of the Verville Air Coach described in these columns. Note in particular the streamlined sponsons projecting from the side of the fuselage

fitted and fastened to the form by means of tacks, clamps, glue, or some binder. After the first layer has been applied, a second layer is assembled, the grain running at an angle to that of the first layer. Each strip is individually glued and is tacked or clamped to the first layer in an effort to produce, as nearly as possible, a homogeneous structure. A fuselage of two or three plies is completed in this way, the final layer usually being covered with fabric to help in binding the structure together. The process is laborious and expensive, although it gives the airplane a light, streamline fuselage.

The new Lockheed process is ingenious, and much more rapid and inexpensive.

The first step in the fabrication process is the construction of a suitable mold. The body lines are first laid out to give the required cargo space, with an elliptical center section tapering gradually to a circular section in front. A wooden form is then built to the exact shape required for one half of the fuselage body, divided on a vertical plane passing through the center line. This form is finished smoothly and made very rigid. It is then suspended with its curved surface downward in a large box. The box is filled with a good grade of concrete, which is carefully tamped to produce a smooth surface against the wooden pattern.

After the concrete has thoroughly hardened, the wooden fuselage pattern is lifted out. Thus, a reinforced concrete block is produced that has a central depression which is just the shape of one half of the finished fuselage.

To assemble a half shell, the outer layer is placed in position in the concrete mold and coated with casein glue. A coat of glue is put on the second layer, and the inner layer is put into place inside the other two. A large rubber air-bag of exactly the shape of the inside of the mold is inserted in the depression, a cover is lowered and bolted down and air pressure is applied to the rubber bag which fills the space between the plywood shell and the cover.

The actual time to complete the process is only about 20 minutes from the application of the first glue until the whole shell is under a pressure of 15 to 20 pounds per square foot. Any slight irregularities in the concrete mold are compensated for by the resilience of the rubber bag. The shell remains under pressure in the mold for about eight hours. The resultant half shell is a homogeneous piece of plywood without joints, cracks, or laps, perfectly glued and exactly streamlined.

The skeleton framework to which the half-shell is applied consists of a series of elliptical laminated spruce rings of varying cross sections, held in position by light spruce strips or longerons.

A Substitute for Control Cables

THE control cables in general use for airplanes present certain difficulties. They have a comparatively short life because single strands of the cable wear out when passing over control pulleys. The cables are susceptible to rust. The connection of cables to levers, control surface horns, et cetera, is a matter of some difficulty and is not a good mass production proposition. A German patent secured by P. Brenner suggests the subsitution for the stranded cables of several thin flat metal bands. These flat metal bands are easily fastened together at their ends by screws and nuts, connections to horns and levers become very simple, and additional short pieces of metal can be readily added where the wear is likely to be large. Provided the metal bands give sufficient flexibility they should be worth considering.

The Verville Air-Coach

ONE of the latest and trimmest additions to the cabin type of passenger carrying monoplane is the Verville Air Coach, first hand information regarding which has been received from the Verville Aircraft Company.

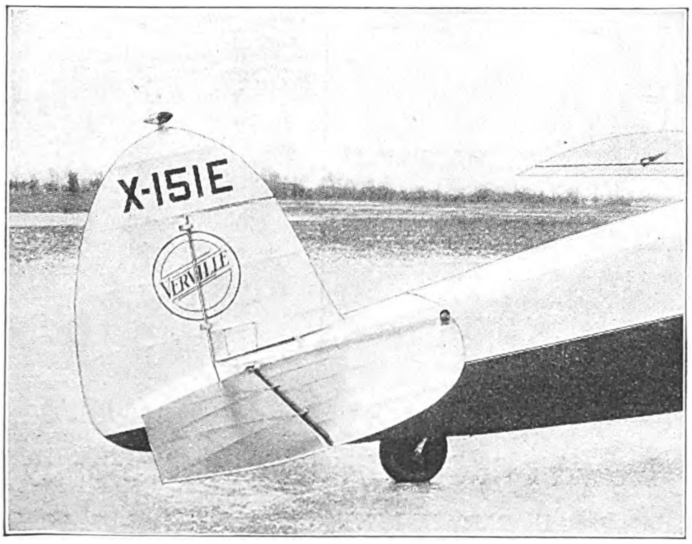
The Air Coach is a four-seater, semi-cantilever plane, which can be equipped with either a Warner Scarab of 110 horsepower, or a Wright Whirlwind of 200 horsepower. With the Scarab, the disposable load is 875 pounds, the speed 110 miles per hour. With the Whirlwind, the disposable load is 1150 pounds and the maximum speed is 125 miles per hour.

Our readers have become familiar with the conventional features of the many cabin monoplanes now on the market, so let us pick out the original and distinctive features of the Air Coach.

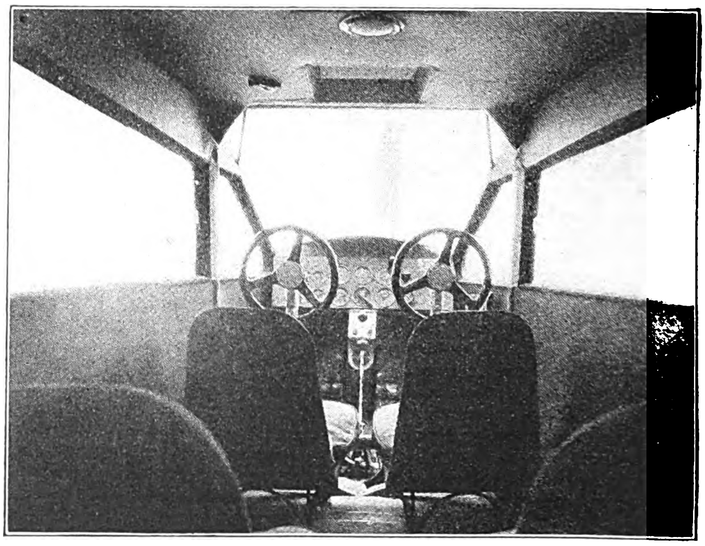
Two short streamline sponsons, or stubs, semi-elliptical in plan form, and 16 inches in length, project horizontally from the lower longerons in the plane of the front struts. To these the forward wing brace struts and chassis oleo struts are attached. By attaching the wing struts in this manner, parasite resistance is reduced, as compared with the conventional type of exposed strut bracing now in vogue. The landing gear struts are attached at the outer extremity of the stubs, allowing an exceptionally wide tread. The stubs or fins serve as small compartments, eight inches deep, with hinged doors on their top sides. The left compartment is used for the lighting battery, and the other for tools.

The rudder is streamlined into the fuselage, which also makes for less parasite resistance. The fin is strongly enough built to dispense with external bracing.

The wings are attached to the fuselage with trunnion type fittings. The wing struts are attached with screw terminals at the top of the struts, so that dihedral angle adjustments are readily possible. This allows the dihedral to be set for the best



The rudder of the Air Coach is streamlined into the rear of the fuselage, and the fin is internally braced

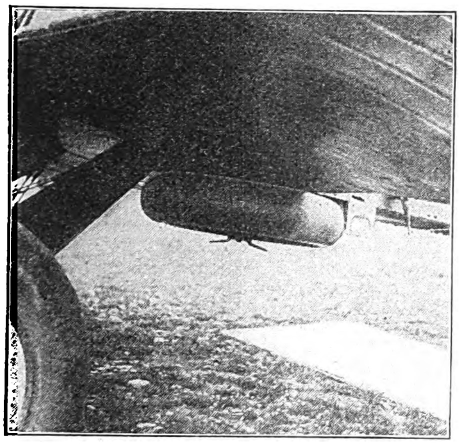


The comfortable cabin of the Air Coach is well arranged. Vision is splendid from all parts of the interior amount of lateral stability. Wing and fuselage blend gracefully into one another. The photographs on the opposite page show the pleasing appearance of the plane.

As we have often insisted should be the case, the Verville Air Coach brings to commercial aircraft many of the speed features of the racer.

Pittsburgh shatter-proof Duplate glass is used in the windows in place of the conventional Triplex.

The four seats in the cabin are bolted to the tubular structure of the fuselage. Upholstering is of Laidlaw's broadcloth. A mat of woven automobile type is laid over the floor. There are four pockets, one on each door, and one on each side wall forward of the doors. Certainly the interior of the cabin looks very attractive and is calculated to give the best possible vision to pilot and passengers alike.



Even airplanes need spare tires on occasion, just as do the best of automobiles. Here is shown how this necessary accessory is carried under the fuselage of an army airplane. This particular photograph was taken of a plane stationed at Portland, Oregon, but army planes at fields all over the country frequently carry their spare tires in much the same fashion

Locking the Handley Page Slot

THE automatic Handley Page slot opens whenever the angle of incidence approaches too closely to the "stalling" point and thus constitutes a great measure of safety for commercial airplanes. An airplane provided with the automatic slot, being less likely to stall, is also less likely to spin. Army and navy pilots have considered this anti-spin characteristic of the slot an objection, since spinning is one of the maneuvers which they must be able to perform at will.

The Chance Vought Corporation has met this objection by applying a locking device to the slot installed on its Vought Corsair biplane, with control from the pilot's cockpit. In the course of some tests by Lieutenant C. B. Harper of the navy, the Corsair was flown to 10,000 feet altitude and deliberately put into a spin. After some ten turns were completed, the slots were unlocked by a lever in the cockpit and the plane recovered from the spin in half a turn.

Another interesting fact brought out by tests on the slotted wing Corsair is that ice formation will not affect the functioning of the slot. On one occasion a heavy layer of ice on the wing interfered in no way with the functioning of the device.

How to judge a used car

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MORE than 130,000 car buyers have saved money by sending for this valuable book, "How to Judge a Used Car." Filled with new pictures and new information, this book tells you how to judge a used car's condition, what speedometers tell; what code prices mean.

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1 Every used car is conspicuously marked with its lowest price in plain figures, and that price, just as the price of our new cars, is rigidly maintained.

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Poison Gas Worse Than A White Elephant

A LARGE quantity of war-time gas recently discovered in a disused dynamite factory near Cologne has been identified as "Blue Cross" gas, which is difficult to destroy with safety. It is considered too dangerous to be taken to sea. The Inter-Allied Commission was communicated with some time ago relative to its disposal, but, as no safe method of getting rid of the unwanted gas could be suggested, it was allowed to remain at the factory. Its interment in a deep underground chamber constructed of steel and concrete has become necessary as the city authorities intend to build houses for their officials in the neighborhood.

Synthetic Tannin Needed

ASIDE from the regrettable loss of beautiful trees and toothsome nuts, the blight which has doomed the chestnut tree in America strikes uncomfortably close to the leather industry, which depends on the wood for vegetable tannin. C. R. Oberfell, writing in *Chemical and Metallurgical Engineering* surveys the future of this material:

"The chestnut tree is doomed, which is a national calamity; but we do not think it will affect the supply of tannin extract for from 20 to 30 years. The disease does not damage the wood—it simply girdles the trunk between the bark and the wood, thus throttling the tree. As long as the wood is sound it is suitable for extract.

"Chestnut wood does not decay rapidly, so aside from the high fire hazard in dead timber, it is believed by many in the extract industry that most of the trees now dead will stand and be available for extract for from 15 to 20 years. Although the blight is now progressing there are still large stands of timber not affected, from which one will see that there will be chesnut extract for many years to come.

"Naturally the situation is serious from a long range viewpoint. Combination sole-leather tannages, that is chrome and vegetable liquors in which the amount of vegetable tannin required is much less than in full vegetable tannage, give more promise than straight chrome of helping out the situation. It might be said that the disadvantages of chrome sole leather are partially offset by this combination process. However, the United States might as well be dependent on imported extract as upon imported chrome salts during a national emergency; and during peace times vegetable extracts will always be obtainable, although not as cheaply as our domestic chestnut.

"There is another possibility which may eventually provide the final solution—that is, synthetic tanning materials. We have had them for 14 years, most of them bad, and only a few partially successful, but the possibility exists. The problem has not received the intensive research which spells success. These materials do not "fill" or pack in between the fibers, giving firmness, wear, and water-resisting qualities to sole leathers, but it is probable that a suitable synthetic tanning material will be developed for the preliminary or pre-tannage, and the "filling" process can be accomplished by the use of so-called "spruce extracts" made from the refined waste liquors from pulp mills. Sufficient study along this line has been done to demonstrate that when economic pressure comes this will be the nature of the final solution."

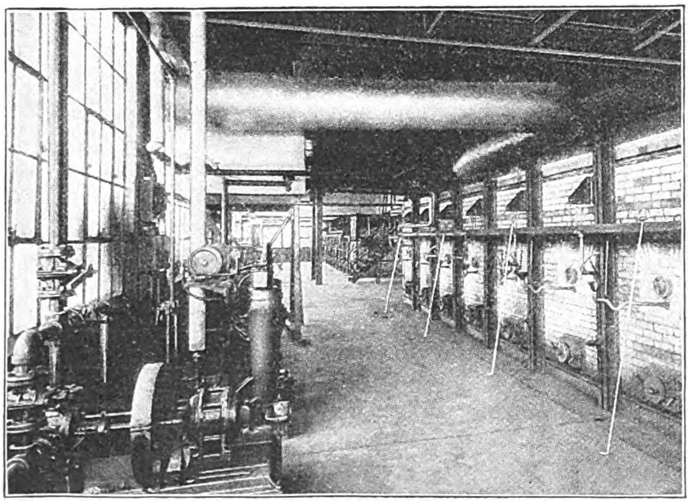
Manufacturing Carbon Products

CHEMISTRY long since established the fact that the brilliant diamond is composed of the same element—carbon—that makes up the drab lump of coal. Carbon, in its lowlier form, finds industrial application in many forms which are none the less essential because of their obscurity. Carbon electrodes are vital to many electrometallurgical operations; carbon brushes are universally used in electric motors, tons of carbon black are employed in rubber compounding and paint manufacture; the familiar dry battery and arc lights both use carbon electrodes; and many other specialties such as telephone disks, lightning arresters, turbine packing rings, telephone back plates, electrical contact points, and elevator contact plates use large quantities of especially fabricated forms of carbon.

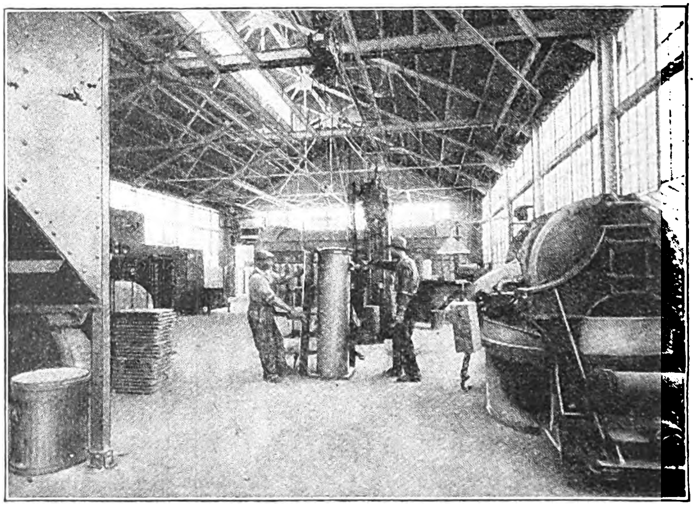
There has recently been completed, at Fostoria, Ohio, a new and splendidly equipped modern plant of the National Carbon Company for the production of carbon products, which is illustrated on this page through the courtesy of R. S. McBride and *Chemical and Metallurgical Engineering.*

"The manufacture of carbon products requires a proper blending of the raw materials, accurately controlled processing, and highly specialized mechanical technique in finishing, in order that the final result may be a carbon exactly suited to the user's needs," says Mr. McBride. "There are infinite varieties of real or imagined needs among users; hence the manufacturer must know just how each change in raw material or in process technique affects the finished product in order that he may make each lot of the desired mechanical, chemical, and electrical characteristics.

"The principal starting materials in the manufacture of carbon products are crude coal tar from which pitch, tar-oils, and other products are made; petroleum oil, from which lamp black is prepared, and the several varieties of artificial and natural graphite, retort carbon, and petroleum coke, which enters into carbon mixes."

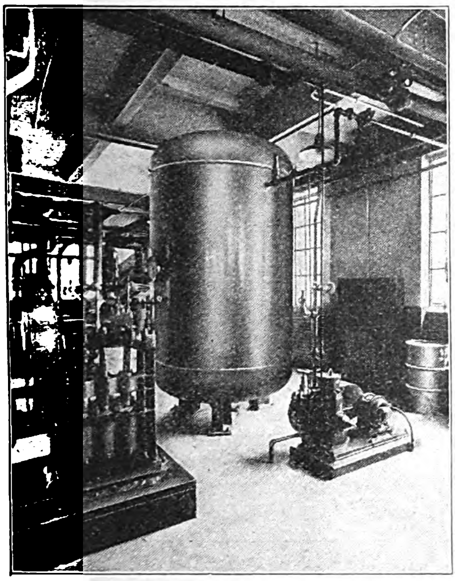


View of the main burner room, where carbon black is produced from the combustion of fuel oil. The oil pumps are visible in the foreground, and another battery of fuel-oil burners can be seen at the rear



In the pug mill at the right, the electrode ingredients are ground to a homogeneous mass, pressed into the desired form, and placed in the clay "sagger" with the proper amount of packing material, to be "baked"

Four principal groups of products are made at the Fostoria works: Extruded electrodes and other rod-like products of small diameter; projector and other carbons, both cored and solid; "therapeutic" carbons; and brush block. Some are extruded products, some are die-press formed, and some may be either extruded or die pressed. In each case the starting material is a carbon or mixture of carbons which has been appropriately tempered with tar or pitch before forming. The handling of the various raw materials up to the stage of mixing for the various products is shown in the raw-material flow sheet of the plant.

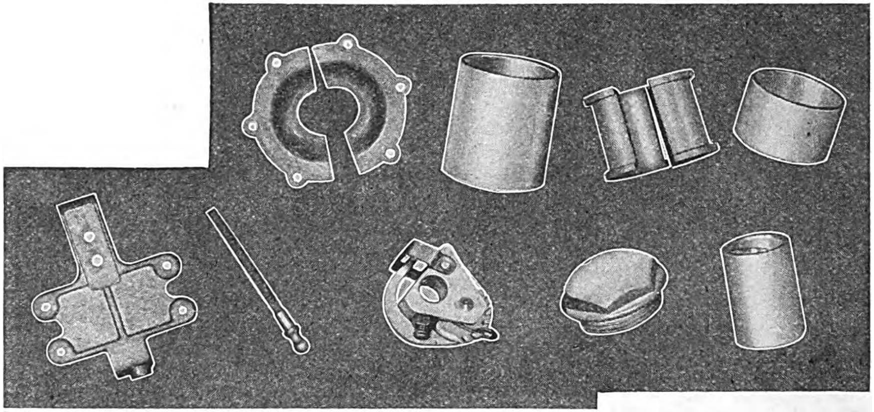


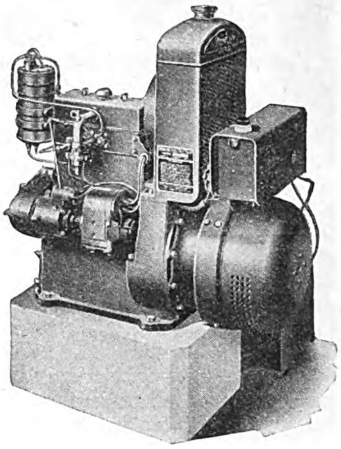
High-pressure water-supply tank and pumps which feed the presses

Coke electrodes, as their name implies, are made with coke as the principal source of carbon; they are the lowest-grade, least-expensive form and are, of course, chosen whenever satisfactorily applicable to the purposes of the carbon user. In the manufacture of coke electrodes the process is essentially mixing of finely ground coke with pitch, blending at appropriate temperature, and extruding or pressing hot. The result is an electrode of approximately the desired size in the "green" condition; this is baked for elimination of the volatile content and then finished accurately to size and shape.

Projector and arc carbons are made by a succession of operations similar to those involved in electrode manufacture. The appropriate mixture of carbons in the form of carbon "flour" is blended in a steam-heated mixer with pitch or tar. The mixture is put through rolls in order to eliminate any lumps of unblended carbon and then sent while hot to the extruding presses. The extruding gives either a solid rod for the ordinary type of arc carbons, or a hollow rod for those special carbons in which the core material is to be inserted. The green rod stock is baked, the baked stock cleaned, cut to the desired lengths, and the core, if any, is inserted. This core material is a mixture of rare-earth fluorides or appropriate metallic oxide which must be rebaked at a low temperature in a batch furnace after being pressed into the hollow center of the carbon. The pointing, butt-end finishing, and electroplating completes the carbon. The cored carbons are given a special test in order to indicate imperfections in the core.

Reducing costs for...
KOHLER of KOHLER





THE Kohler Automatic Light Plant provides an outstanding example of the manufacturing economies which can be effected through the proper application of die castings.

In this particular assembly, ten Milwaukee Die Castings made of four different alloys are used. Undoubtedly some of these parts could be made of other materials and by other methods, but Kohler engineers were convinced that correctly designed die castings would serve the purpose more effectively at a much lower cost.

YOUR PRODUCT and DIE CASTING

This non-technical booklet on the die-casting process will help you decide whether or not parts of your product can be die-cast to advantage.

The engineers were right! On four parts, alone, the use of die castings has eliminated nine machining operations, three patterns and five jigs, reducing the cost approximately 50%.

Perhaps a survey by Milwaukee Die Casting Technicians would uncover the possibility of similar savings in the manufacture of your product. Why not have one made without cost or obligation?

MILWAUKEE DIE CASTING COMPANY
287 FOURTH STREET MILWAUKEE, WIS.

MILWAUKEE
DIE CASTINGS AND BEARINGS

This is essential because if there be an imperfect core it interrupts proper functioning of the carbon and the arc will go out.

Although the operation is not conducted at this plant, this company produces carbon electrodes as large as 40 inches in diameter and 10 feet long.

Pyroxylin Shatter-Proof Glass

FIVE hundred automotive engineers, executives of safety councils, and journalists were asked to vote on which of seven improvements for motor cars made during the past year they considered most essential. Non-shatterable glass led the field; in fact, it received almost as many votes as the next three innovations together—automatic chassis lubrication, light control on steering wheels, and vibration dampeners.

Now what is non-shatterable glass? *The DuPont Magazine* tells us to think of a cheese sandwich. Instead of two pieces of bread, think of two panes of thin plate glass. Instead of a slice of cheese, think of a sheet of transparent Pyralin. Instead of butter think of a colorless liquid with adhesive properties. Make a sandwich of these materials and you have it—all expect the process of binding these components together. That is done by heat and hydraulic pressure.

The discovery that a sheet of pyroxylin plastic cemented firmly between two pieces of glass makes a non-shatterable product is by no means a new one. As a matter of fact the original patents taken out on this idea have expired. But the technique of producing really transparent material which would not discolor with age has called forth considerable chemical skill. In its maufacture only the purest ingredients are used, and the equipment has been modified so that the materials are kept in closed systems throughout the process. Cotton from certain sources only is used, and water of a prescribed mineral content. The acids are specially treated before nitration. Other ingredients such as color, stabilizers, plasticizers, and the like are very accurately controlled chemically. Filtered air is used at various stages, and only trained operators of the highest type are capable of handling the work.

Remarkable Metal Shell Reported

REPORTS of a new process for coating almost any substance with a uniform shell of metal of any desired thickness emanate from England, via *Chemical Age*. The process is described as a discovery whereby all kinds of materials of any shape or contour, both conductors and non-conductors of electricity, can be metalized by electrochemical action to any desired thickness.

It is alleged that by the new process wood, aluminum, duralumin, tile, brick, plaster, et cetera, can be metalized for use in the building and allied trades. The materials are rendered damp-proof and fire-proof with greatly increased strength. Metal work can be rendered non-corrosive, and wood mouldings can be treated with bronze, brass, et cetera, for use on shop front and decorative interior construction. Doors, window sashes, wainscotings, panel boards, and panelling can be artistically metalized with one metal on another. Materials such as cardboard or plywood can be given increased strength and resistance to the corrosive action of steam, heat, chemical fumes, and water. Linen, gauze, silk, leather, et cetera, can be delicately metallized with handsome results. Many airplanes and seaplane parts will, it is stated, be manufactured by this process, for great strength can be obtained and perfect resistance to water corrosion given. The cost of metalizing goods by this process is said to be extremely low.

Hydrogenating Brown Coal on a Commercial Plant Scale

OF almost as great interest as the German nitrogen fixation and fertilizer manufacture is the large experiment which the I. G. is making in the hydrogenation of coal at the Merseburg works, says *Chemical and Metallurgical Engineering*. Here the Bergius process, modified, it is reported, by the addition of a catalyst, is being operated on a large scale. The work was logically undertaken at Merseburg because the raw materials—coal and hydrogen — were available at lowest cost. Further, it was possible to draw up the extensive experience already gained in the technology of high-pressure, high-temperature processes.

It is understood that the hydrogenation process has not yet been developed to the profitable stage, but that the prospects are favorable for financial success this year. However that may be, coal is being processed at the rate of 1000 tons per day. It is finely incorporated with heavy oil to the consistency of putty, pumped into large containers and treated with hydrogen at high temperature and pressure. At the end of the contact period the mass is practically liquified. The liquid is filtered from the ash and unconverted residue and distilled. At present only one fraction is recovered, namely that suitable for motor fuel. The heavy oil remaining is incorporated with fresh coal and returned to the hydrogenation process.

Oil and Water Mix Too Well

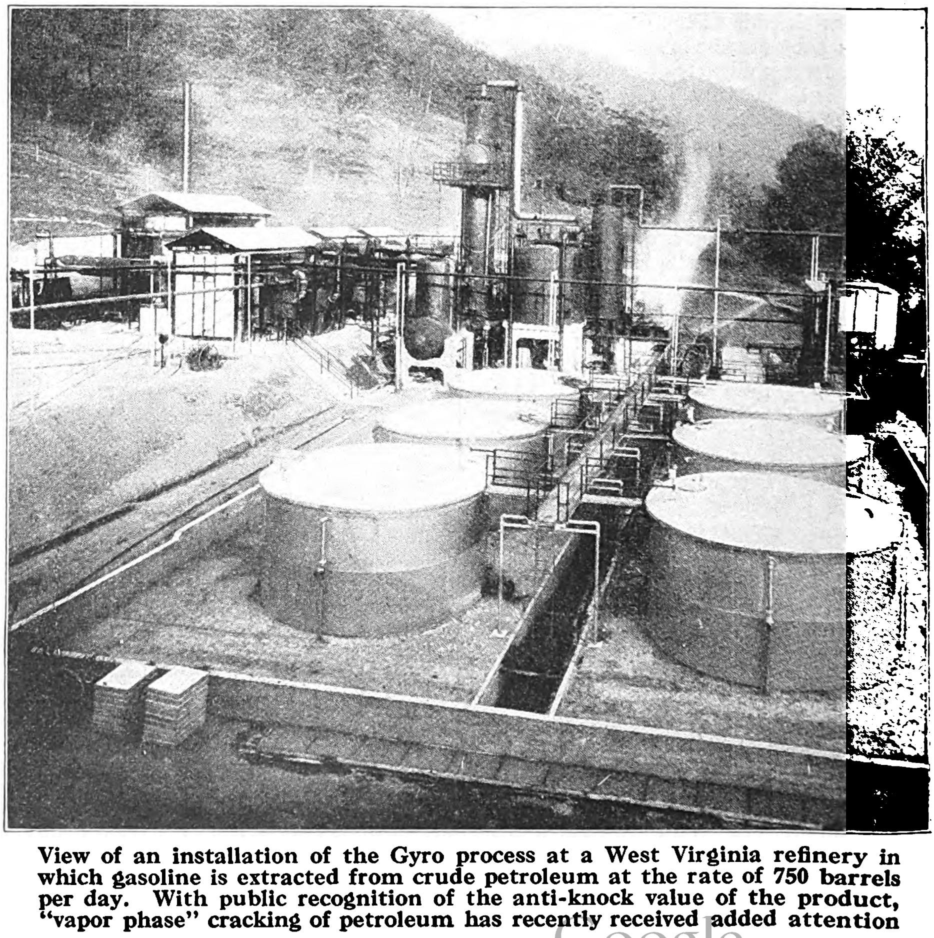
OIL and water will mix, said Dr. Gustav Egloff, Chicago chemist, before a recent meeting of the Institute of Chemistry. They mix so well that science has difficulty trying to separate them. Nature every year burdens the oil industry with over 2,000,000 barrels of intimately mixed oil and water as emulsified crude oil. Such oil does not separate its water even after years of storage.

There are at present over 100,000,000 barrels of emulsified crude oil in storage tanks and in sump-holes in the ground and the refiner is at his wits' ends as to how to separate the oil from the water. Thus over 100,000,000 dollars is tied up in stored emulsified oil, for whose utilization no really economical method has been evolved which is applicable to all situations.

There is no adequate background of theory to explain the involved nature of emulsified oils. Some have water in fine droplet form dispersed through the oil and making up 95 percent of the total. Wholly satisfactory explanations are lacking as to how they are formed or the process that takes place when they are broken into oil and water.

Many Uses for Soluble Silicates

MANY readers have an acquaintance with silicate of soda as "water glass" for egg preserving, but very few realize the great number of other uses to which the various soluble silicates can be put. James G. Vail, chemical director of the leading



View of an installation of the Gyro process at a West Virginia refinery in which gasoline is extracted from crude petroleum at the rate of 750 barrels per day. With public recognition of the anti-knock value of the product, "vapor phase" cracking of petroleum has recently received added attention manufacturer of silicate of soda in the United States, gives detailed information about practically all the current chemical and industrial uses of the silicates in a fascinating book, just published, called "Soluble Silicates in Industry." The wide variety to be found in the chapters on different kinds of uses will be obvious from a simple mention of a number: dental grinding wheels, spark plugs, silicate cement, asbestos pipe covering, wallboard, adhesives, silk weighting, pottery glazes, ore floatation, laundering, cleaning aluminum, water softening, straw paper manufacture, and medical uses.

New German Disinfectants

ABOUT 95 plants in Germany now manufacture disinfectants for general and hospital use. The new process of distilling tar and tar products from coal at low temperatures offered the possibility of producing phenol products which possess good germicidal qualities. The Mathias Stinnes mine in Karnap has erected a plant which has been continuously manufacturing these products for over a year. They are known under the names of "ufinol" and "tusputol." "Ufinol" is used for general disinfection while "tusputol" is used for disinfecting the saliva of tubercular people and for the disinfection of clothing, et cetera. These two products formerly retained the odor of phenol; however, it is now reported that a process has been found to deodorize them and even to give them a pleasant odor, which has resulted in greater use by hospitals and sanitariums.

The further products gained through low-temperature carbonization are "stabinol" and "pethanol." "Stabinol" is used for the disinfection of animals and stables and has qualities similar to "ufinol." "Pethanol" is used for killing all kinds of plant insects. It is alleged by the producers that blood, tree, and wool lice are killed without the least damage to the leaves. The insecticide may be used in a 1 percent solution for spraying at all times of the year, an advantage, it is claimed, over other insecticides which usually contain at least a 20 percent solution and therefore hurt the leaves. Experiments are being made in the use of "pethanol" for soil disinfection and to combat blight on elm trees.

Toes As Weather Prophets

MANY people have attributed to their toes the power to foretell changes in the weather, little realizing that the pain was merely an indication that the leather in their shoes was shrinking. J. Arthur Wilson, the foremost leather chemist of America, who was recently awarded the Chandler Medal for his distinguished contributions to leather technology, explains the phenomenon as follows:

"In going from a dry to a moist atmosphere, chrome leathers increase in area by an average of about 18 percent. They shrink in area correspondingly when the relative humidity falls. Vegetable-tanned leather, on the other hand, undergoes changes in area only one third as great as this. For reasons that had nothing to do with the comfort and happiness of the ultimate consumer, it became desirable for the tanner and shoe manufacturer to have about 95 percent of all the sole leather vegetable tanned, and about 95 percent

(*Please turn to page* 373)

This Book costs you nothing and may save thousands in your plant!

WHAT HAPPENS IN COUPLINGS
FATIGUE OF MATERIALS
What it is and how it occurs in Flexible Couplings
H. F. MOORE

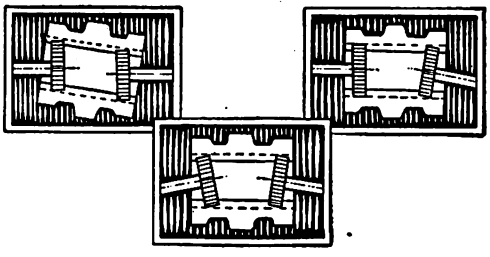
Shut-downs from coupling failure cost money and can be avoided

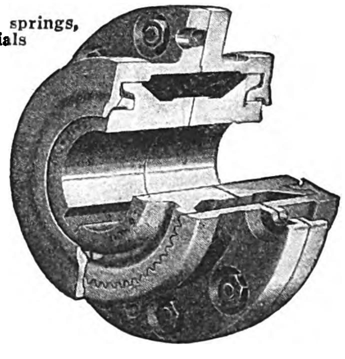
Since early days, old-type flexible couplings have depended on flexible materials (rubber, leather, fibre, spring-steel) to provide the "give" necessary to take up misalignment.

What makes this flexible material break down? Read this short book. It is by one of the outstanding authorities on Fatigue of Materials. See that the way to eliminate failure is to eliminate flexible materials—as done in Fast's Self-Aligning Coupling.

Learn why the Fast principle of mechanical flexibility entirely eliminates all chance of coupling failure, thus avoiding coupling shutdowns in your plant. See the interesting diagrams showing the evolution of coupling practice, and the way Fast met the problem.

The coupling without flexible bushings, pins, springs, discs, grids or any other flexible materials





Two spur gears, one on each shaft end, are completely and continuously meshed in oil with the internal gears of a floating sleeve. The shafts and sleeve revolve noiselessly as one unit, allowing free angular and lateral movement.

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Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Municipal

THE MODEL MUNICIPAL TRAFFIC ORDINANCE, by C. W. Stark, is a significant paper dealing with the need for standard traffic laws. The model municipal traffic ordinance, if generally adopted, would reduce confusion and would cut down the number of accidents on public streets and highways. The plan is comprehensive, yet sufficiently elastic to meet the needs of all communities, whether large or small. *National Conference on Street and Highway Safety, U. S. Department of Commerce, Washington, D. C.—Gratis.*

DISPOSAL OF WASTE CRANK-CASE OILS, by J. B. Gordon, Sanitary Engineer of the District of Columbia, is the report on a recent survey showing how waste crank-case oil is disposed of in 46 important cities in the United States and abroad. The report presents certain well-planned recommendations, based upon the results of recent tests by the Bureau of Standards in which it has been proved that by a commercially practical process of re-refining, oils suitable for re-use in automobile motors can be recovered from waste crank-case oil. *J. B. Gordon, Sanitary Engineer, District of Columbia.—Four cents.*

THE PROBLEM OF AUTOMOBILE EXHAUST GAS IN STREETS AND REPAIR SHOPS OF LARGE CITIES, REPRINT 1217, from *Public Health Reports,* will be of interest to many of our readers. *U. S. Government Printing Office, Washington, D. C.—Five cents.*

Construction

THE LAMELLA ROOF is a well illustrated 30-page brochure describing the new trussless roof construction that is in increasing demand for large unobstructed floor areas with the roof supported by walls only. The booklet traces the origin of the design, and illustrates its methods and advantages. *National Lumber Manufacturers' Association, Transportation Building, Washington, D. C.—Gratis.*

SEASONING, HANDLING, AND CARE OF LUMBER, a 96-page report with 40 illustrations, is an account of the methods used in seasoning lumber and the changes which take place in the wood during the process. A bibliography is included. *U. S. Government Printing Office, Washington, D. C.—25 cents.*

AIRPLANE HANGAR CONSTRUCTION, revised edition, is a well illustrated 40-page booklet containing information to assist airport authorities, manufacturers, aviation companies, and others who are interested in airport and hangar construction. The new regulations of the Department of Commerce for rating airports has been added, with an analysis of modern requirements for constructing hangars of requisite size. *National Lumber Manufacturers Association, Transportation Building, Washington, D. C.—Gratis.*

GENERAL BUILDING CONSTRUCTION WITH SLAG CONCRETE, SYMPOSIUM NO. 12, is one of a series of illustrated bulletins pertaining to the characteristics and uses of blast-furnace slag. *National Slag Association, 937 Leader Building, Cleveland, Ohio.—Gratis.*

Metallurgy

A STUDY OF CENTRIFUGALLY CAST PIPE *vs.* SAND-CAST PIPE, by F. N. Menefee and A. E. White, is the report of an investigation undertaken at the request of the Water Board of the City of Detroit to determine the relative merits of sand-cast pipe and pipe centrifugally cast in metal molds. The report also includes some interesting discussion on the subject. *Department of Engineering Research, University of Michigan, Ann Arbor, Michigan.—Fifty cents.*

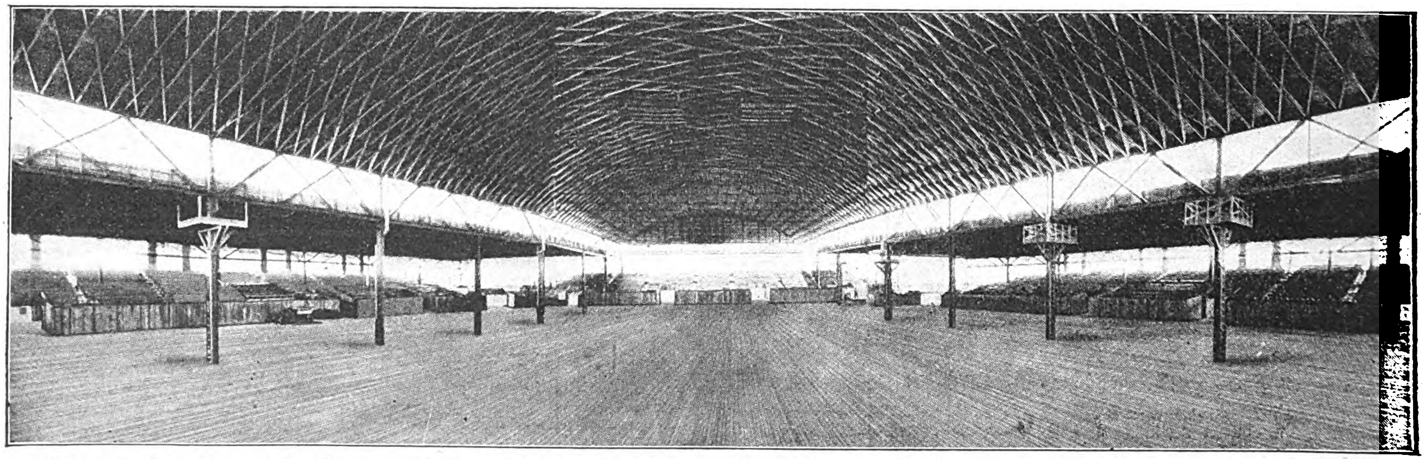
THE STABILITY OF METALS AT ELEVATED TEMPERATURES, and STAINLESS STEEL, A DIGEST WITH ABSTRACTS AND BIBLIOGRAPHY are two bulletins by Claude L. Clark and Albert E. White that will be helpful to those seeking reliable information on these subjects. *Department of Engineering Research, University of Michigan, Ann Arbor, Mich. "Stability of Metals,"—One Dollar. "Stainless Steel,"—50 cents.*

A STUDY OF CHROMIUM PLATING, by Richard Schneidewind, is a comprehensive study of chromium plating, based upon the results of a two year research program financed by the Detroit Edison Company. It is designed to help executives and engineers interested in chromium plating in a general way, and to aid electrochemists with a detailed account of the original research done at the University of Michigan during 1927 and 1928. Important information as to scientific and patent literature on the subject is included in the booklet, which has 141 pages and is illustrated. *Department of Engineering Research, University of Michigan, Ann Arbor, Mich.—One dollar.*

Petroleum

STUDIES IN FRACTIONAL DISTILLATION OF CRUDE PETROLEUM, BUREAU OF STANDARDS TECHNICAL PAPER NO. 431, will be of interest to all who are connected with the oil industry. The booklet contains 58 pages and 16 illustrations. *U. S. Government Printing Office, Washington, D. C.—15 cents.*

ELECTRIFICATION IN THE PETROLEUM INDUSTRY, CIRCULAR 1820, discusses the many practical and economical applications



This interior view of the Democratic National Convention Hall in Houston, Texas, shows the construction of a Lamella roof. This type of trussless roof was chosen to provide large floor space unobstructed by columns

of electricity in the various branches of the oil industry. *Westinghouse Electric and Manufacturing Company, 150 Broadway, New York City.—Gratis.*

NATURAL GASOLINE IN 1927, by G. R. Hopkins, is the most recent statistical compilation of the Bureau of Mines relating to the rapidly expanding natural gasoline industry. *U. S. Government Printing Office, Washington, D. C.—Five cents.*

Miscellaneous

METHODS OF DETERMINING THE HYDROGEN-ION CONCENTRATION IN SOILS, CIRCULAR 56-C, of the Department of Agriculture, describes the latest methods and equipment used in testing soils for pH values, to determine the degree of acidity or alkalinity of the soil. The significance of the pH value in agricultural soils is also explained. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

IMPORTED PARASITES OF THE EUROPEAN CORN BORER IN AMERICA, TECHNICAL BULLETIN 98, by D. W. Jones of the Bureau of Entomology, Department of Agriculture, is a valuable and interesting summary of the campaign being waged against the corn borer. Complete information as to the value and habits of the various imported parasites is presented in this 27-page bulletin. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

THE TRUTH ABOUT SNAKE STORIES, by Karl P. Schmidt, is an attempt to de-bunk our store of fanciful legends about the strange powers and behavior of various kinds of snakes. Similar leaflets of the Field Museum treat such subjects as "The American Alligator," and "The Wild Turkey." *Field Museum of Natural History, Chicago, Ill.—20 cents.*

UNIDIRECTIONAL RADIO BEACON FOR AIRCRAFT, RESEARCH PAPER NO. 35, describes the new developments for guiding aircraft with directed radio beams. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

OPPORTUNITIES FOR ENGINEERS IN THE UNITED STATES CIVIL SERVICE includes a table showing salaries and distribution of government engineers. *U. S. Government Printing Office, Washington, D. C.—Gratis.*

METHODS OF TEST RELATING TO ELECTRICAL INSULATING MATERIALS, a 155-page pamphlet, is an outline of tests and specifications showing ways to determine the relative merits of various materials used for electrical insulation. *American Society for Testing Materials, 1315 Spruce Street, Philadelphia, Pennsylvania.—85 cents.*

PHYSICAL PROPERTIES OF DENTAL MATERIALS is a 28-page report on an investigation conducted by the Bureau of Standards regarding the important properties of gold alloys in the various forms used in dentistry. *Superintendent of Documents, United States Government Printing Office, Washington, D. C.—35 cents.*

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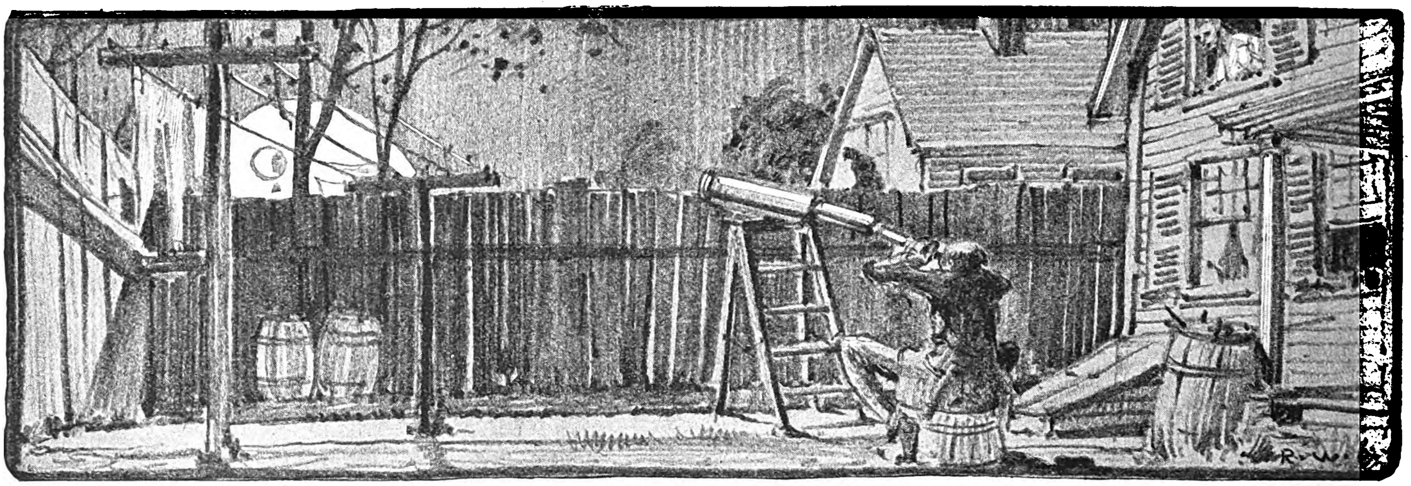


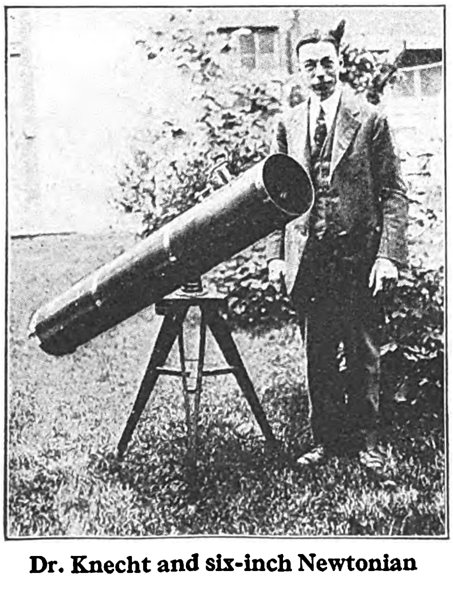
The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

"I ATTENDED the Telescope Makers Convention in Springfield, Vermont, in 1927, and became so much interested in the work, that since then I made two telescopes—a six-inch Newtonian, and later an eight-inch Herschelian," writes Dr. D. George Knecht, 35 North Ninth Street, Allentown, Pennsylvania.

"Living in a closely built up section in Allentown, with high buildings and bright lights all around me, which interfere so much with this work that it is very unsatisfactory, I made the telescopes portable so that I can take them out into the country or to some open space where I have a good view of the sky and can be away from the bright lights. For this reason I am using a tripod.

"The mounting of the Newtonian telescope is made of steam fittings. I used a 45 degree angle, a 90 degree angle, three close nipples and two floor flanges. When I assembled these I had an equatorial mounting; giving me motion in right ascension and in declination. Using the threads for bearings, I have a very easy and steady motion of the telescope. However, the nipples plumbers keep in stock are all tapered from the middle toward the ends. They are especially made this way to make steam-tight joints, but they do not work well in a telescope mounting, so I had straight nipples made by a machinist.



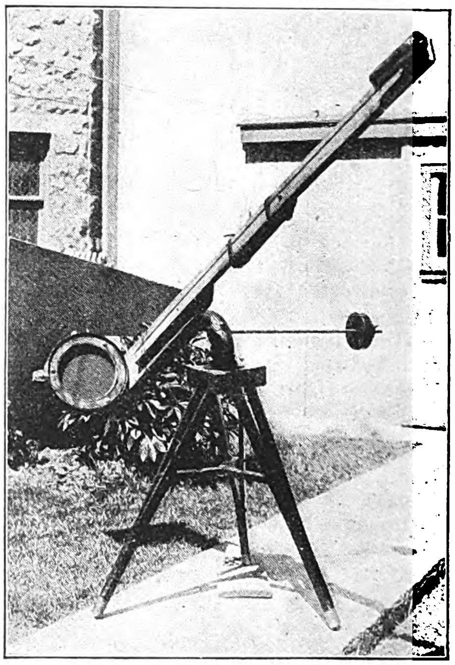
Dr. Knecht and six-inch Newtonian

"I live in latitude 40 degrees 43 minutes, so the 45 degree angle is just a little more than four degrees short of a polar axis. To correct this I tilt my tripod just a little toward the north and thus I get an approximate polar axis. If I were to put this mounting on a concrete post or a section of a water main, I would correct it by putting a wedge under the base flange, and tilting the mounting enough so that the 45 degree angle would point exactly to the pole of the heavens."

William J. Davis, 7736 Elmgrove Drive, Elmwood Park, Illinois, has discovered that an old swivel chair need not be retired to the attic or sent to the junk-heap. He writes: "After giving my telescope a six month trial, I believe it is time for me to tell the Telescope Editor about it. My mirror is a six-inch, ground and polished to a focal length of 45 inches. I made my own diagonal and two low-power eyepieces. The mount is from a discarded swivel chair, with the seat removed and the end of the legs cut off.

"I believe I have an exceptionally good parabolic mirror because of the good definition I sometimes get of the stars when using a quarter inch eyepiece. I don't see why anyone should stand up and bend over to polish a small size mirror. I used a table and sat down during the whole process."

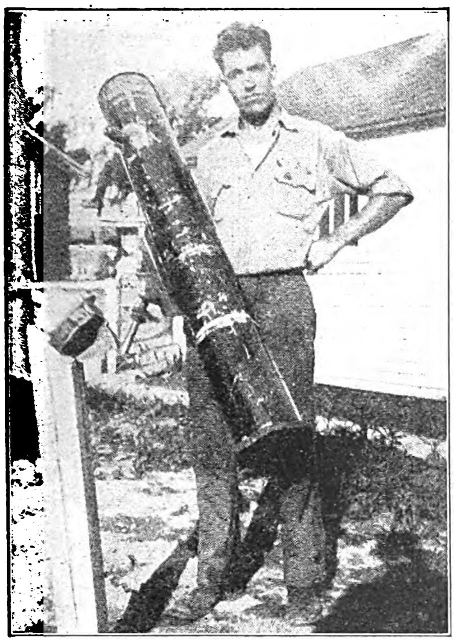
G. C. Hanley of Mincha (no state, no country, mentioned) sends in a brief note about his telescope, with two photographs. He writes on the letterhead of the "Mincha Butter Factory—Pasture Gold Butter." No acknowledgement could be sent him because the address was incomplete. No Mincha is listed in the United States Postal Guide, and none appears in our gazeteer of the world. However, we located Mincha—at least we believe it is somewhere on earth, and presumably not far from one of the two 36th parallels of latitude. A protractor placed on the polar axis of the telescope in the illustration proves this. There is no clue, however, to the longitude, but one of the photographs (not reproduced) shows a tree that looks exotic. Our hunch is therefore—Australia. Down there a polar axis is still parallel to the earth's axis but it points south, not north (its lower end points north). The Sun daily crosses the northern, instead of the southern, heavens; but it still rises in the east. In short, everything is mixed up—which is probably just what an Australian amateur thinks about things up here "on top" instead of "down under," where he lives. Mr. Hanley writes:



Dr. Knecht's eight-inch Herschelian

"I am sending you some photos of the eight-inch telescope I made with the help of the article in the SCIENTIFIC AMERICAN. This is the second telescope I have made. The first was a four inch. It had a good mirror except for a turned-down edge. The eight-inch mirror had a raised zone, but after a few nights' work I got it figured correctly.

"The mounting is made almost entirely from pipe fittings and old Ford parts. Slow motion is obtained by having a lug on the

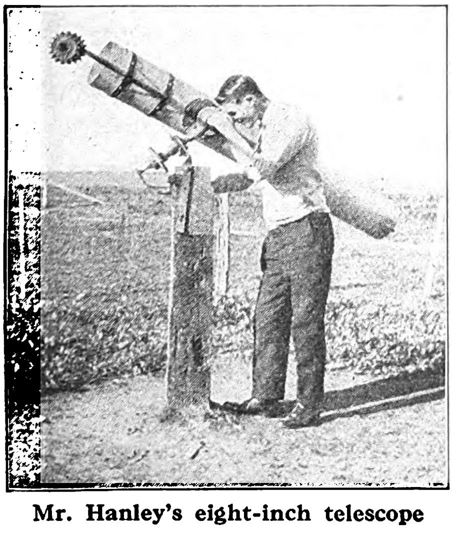


Mr. Davis and swivel-chair mounting

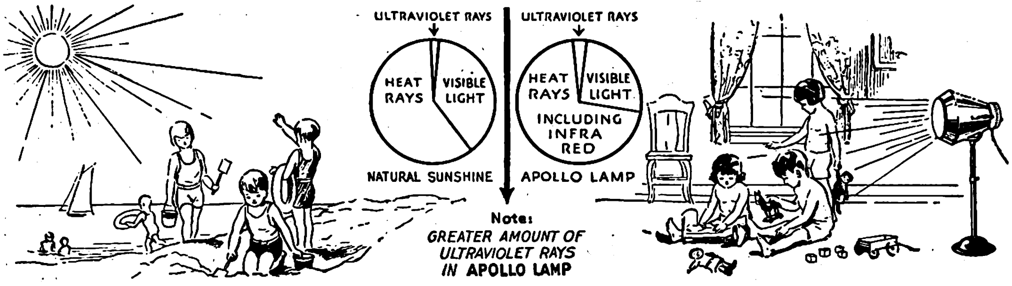
edge of the friction disk, coupled to a long-threaded bolt. This method gives good control. I have not yet fitted the slow-motion control to the declination axis. The telescope controls very well as it is."

Amateurs whose telescopes are completed will find plenty of serious work to perform with them. One possibility is contained in a paper entitled "Photographs of Venus" by Prof. Frank E. Ross of Mt. Wilson Observatory, published in Number 1, Volume 68, of the *Astrophysical Journal.* To quote: "In view of the success of Mr. A. Rordame in securing photographs of a marking of this nature in full daylight, a field offering results of value is opened to amateurs possessing only very modest equipment." In the work referred to, a nine-inch refractor had been used, and markings on Venus were photographed on commercial film. A 12-inch reflector should easily give comparable results; even a 10-inch might.

Someone has raised the question: Who first originated the common method of grinding and polishing specula—the equal sized disk and tool method, in contradistinction to the older small-tool method? The credit for this discovery evidently belongs to Dr. Elihu Thomson, now Director of the Thomson Research Laboratory of the General Electric Company, a Corre-



Mr. Hanley's eight-inch telescope

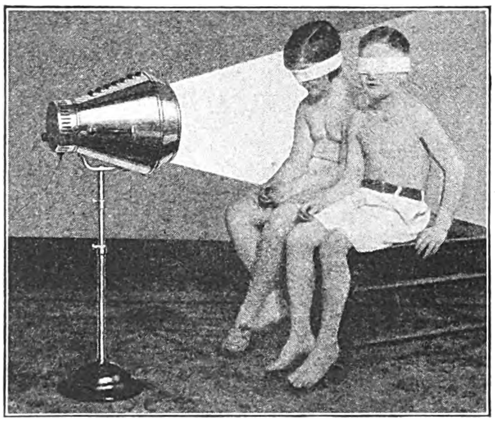


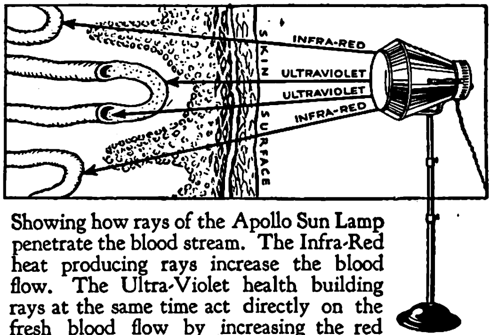
This is the Sun-Rival Whose Rays Penetrate the Blood Stream

By dilating the capillaries (minute blood vessels) the new Apollo Ultra-Violet Sun Lamp stimulates the flow of blood from the depths to the surface through the layers of muscular tissue. It regularizes the circulation and revives a sluggish muscular system. Its tonic action stimulates new life in the vital organs. It sharpens the appetite, aids digestion and normalizes the functions of the entire endocrine system.

Apollo Ultra-Violet Rays by entering the blood stream, charge the calcium in the blood with Ultra-Violet electrical energy, speeding up the process of metabolism and supplying vitamin D. The Calcium in the blood is more quickly transformed into body structure in the continuous process of cell building and rebuilding. The red corpuscles are multiplied—anemia is relieved and the leucocytes in the blood which fight off disease germs, are given new strength and vigor. Remember it is not the heat, but the light that heals.

Sun-Starvation Prevents Perfect Health





Showing how rays of the Apollo Sun Lamp penetrate the blood stream. The Infra-Red heat producing rays increase the blood flow. The Ultra-Violet health building rays at the same time act directly on the fresh blood flow by increasing the red corpuscles and charging the Calcium in the blood for quick transformation into body cell structure.

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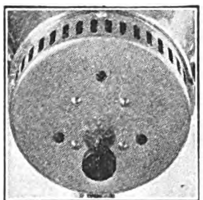
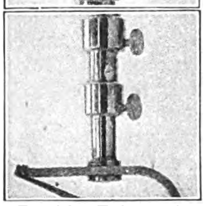
Profit now by the knowledge and experience of men like Dr. Rollier of Switzerland, Dr. Schuind and others whose scientific tests have shown these Ultra-Violet Rays to outweigh all health building ray treatments known to the category of light and electricity. Decide now that you too will join the happy folks who live and breathe in a body well nourished with nature's greatest gift.

You will be particularly pleased to learn that the design and construction simplicity of the new Apollo now brings this superior Ultra-Violet Sun Ray Lamp to you at an amazingly low cost. Let us tell you more about it.

Note: Simple Knob Adjustment





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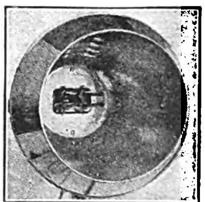
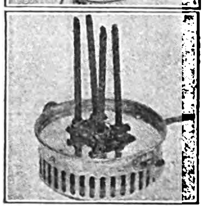
Notice the Twin Carbons





Observe Ease of Carbon Change

Einstein's New Theory

is partially based, as he himself states, on the work of the famous astronomer

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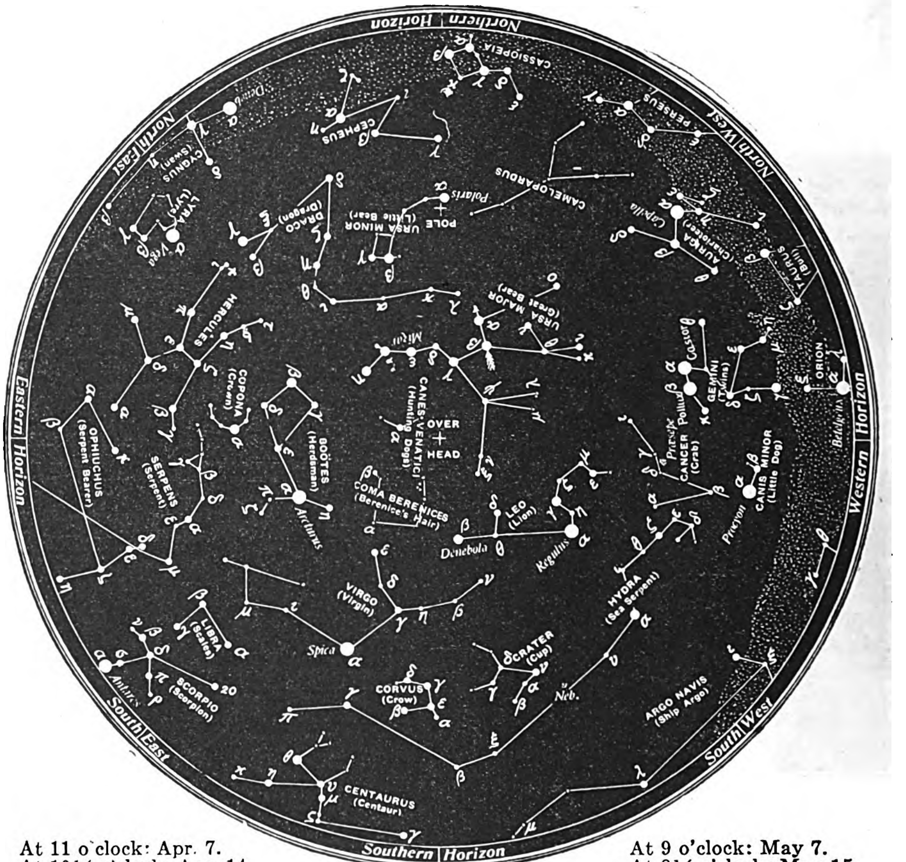
sponding Editor of this journal. In 1878 Dr. Thomson described it in the *Journal of the Franklin Institute* as "A New Method of Grinding Glass Specula." The question was referred to Ellison, who also believes Thomson deserves the credit. He suspects Short, an early professional, had previously hit upon the same method, about 1750. If so, he kept it a secret, and therefore deserves no credit.

Finally, a bit of good news: our friend Russell W. Porter, by common consent the leader of all the American amateur telescope makers and co-author of "Amateur Telescope Making," has been honored by a call to California by those who are in charge of plans for the new 200-inch telescope. The project is co-operative between California Institute of Technology and Mount Wilson Observatory. Mr. Porter will take part in the design of the instrument and optical shops required in connection with the new Astrophysical Observatory, and will also co-operate on the design of the great 200-inch telescope and other instruments. He retains his connection with Vermont, but he has also been designated Associate in Optics and Instrument Design at the California Institute of Technology. All amateurs will wish him success and follow his progress with keen interest.—*A. G. I., Tel. Ed.*

The Heavens in April

By PROF. HENRY NORRIS RUSSELL, Ph.D.


Northern Horizon
North East
North West
Eastern Horizon
Western Horizon
South East
South West
Southern Horizon
CASSIOPEIA
CEPHEUS
Deneb
CYGNUS (Swan)
LYRA (Lyre)
Vega
DRACO (Dragon)
URSA MINOR (Little Bear)
POLE
Polaris
CAMELOPARDUS
PERSEUS
Capella
AURIGA (Charioteer)
TAURUS (Bull)
URSA MAJOR (Great Bear)
Mizar
HERCULES
CORONA (Crown)
BOÖTES (Herdsman)
Arcturus
CANES VENATICI (Hunting Dogs)
OVER HEAD
COMA BERENICES (Berenice's Hair)
OPHIUCHUS (Serpent Bearer)
SERPENS (Serpent)
Castor
Pollux
GEMINI (Twins)
ORION
Betelgeuse
Praesepe
CANCER (Crab)
CANIS MINOR (Little Dog)
Procyon
LEO (Lion)
Regulus
Denebola
VIRGO (Virgin)
Spica
LIBRA (Scales)
SCORPIO (Scorpion)
Antares
HYDRA (Sea Serpent)
CRATER (Cup)
CORVUS (Crow)
Neb.
ARGO NAVIS (Ship Argo)
CENTAURUS (Centaur)

At 11 o'clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o'clock: Apr. 22.
At 9½ o'clock: April 30.
At 9 o'clock: May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 23.

The hours given are in Eastern Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on April 7, etc.

NIGHT SKY: APRIL AND MAY

Mercury is in conjunction with the Sun on the 17th. Although theoretically a morning star before that date and an evening star afterward, he is practically invisible.

Venus is an evening star when the month begins and sets a little after 8 P.M. She is rapidly overtaking the earth, and on the 20th she passes between us and the Sun and becomes a morning star. Owing to the inclination of her orbit she passes more than five degrees to the north of the Sun, so that a watchful observer in a good climate would find that only a few days elapsed between his last glimpse of her in the twilight and her reappearance in the dawn.

Mars is now past quadrature and an evening star, but very far north of the equator; he remains in sight for an hour after midnight.

Jupiter is an evening star setting at 9 P.M. on the first and about 7:30 on the 30th.

Saturn is in Sagittarius and rises at midnight in the middle of the month.

Uranus is in Aries, too close to the Sun to be seen; and Neptune is in Leo, observable all the evening.

The moon is in her last quarter at 2 A.M. on the 2nd; new at 4 P.M. on the 9th; in her first quarter at 9 A.M. on the 16th; and full at 5 P.M. on the 23rd. (These hours, as is always the case in this summary, are Eastern Standard Time—not "daylight saving.") She is nearest the earth on the 12th and farthest away on the 1st—and again on the 28th. During the month she passes Saturn on the 1st, Uranus on the 8th, Mercury on the 9th, Venus on the 10th, Jupiter on the 11th, Mars on the 15th, Neptune on the 18th, and Saturn a second time on the 28th.

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Industries From Atoms

(Continued from page 367)

of all the shoe-upper leather chrome-tanned. When this was brought about, no one suspected the differences of shrinkage and expansion of the two kinds of leather. The shoe upper is thinner and tends to reach equilibrium with the air much more quickly than the very thick sole, and so the changing size is much more effective when the upper is chrome-tanned.

"Nearly everybody wears shoes with chrome-tanned uppers, which are subject to these great size changes with changing atmospheric conditions. For this reason most people suffer unnecessary discomfort. The tanner will use any method of tanning which the consumer demands, but like most people, is slow to make a change until the demand is urgent. The interesting scientific fact is that the kind of tannage so greatly influences the power of leather to take up water and change in size."

"Dope" Makes Money Last Longer

MOST of us are interested in making money go as far as possible, and government chemists are constantly at work to achieve the same end. Through the use of paper having increased fiber strength, the proportion of the United States paper money that is redeemed because of its being broken or torn has been reduced until it is almost negligible. Most of the paper currency that is now withdrawn from circulation on account of being considered unserviceable is declared unfit because of oil or grease stains, dirt, creasing, and other evidences of surface wear.

At present, sheets of notes are resized with animal glue, but the demands of large-scale production have prevented the employment of the low-temperature drying methods that are essential for preserving in full the improvements contributed by the glue. The addition of tanning materials, such as formaldehyde, and of softening agents, such as glycerine, to the freshly sized paper has been studied, and the use of such reagents seems to offer considerable promise of improving the resistance of the resized notes to surface wear.

Various lacquers and varnishes have also been included in the investigation. Both cellulose nitrate and cellulose acetate lacquers or "dopes" have been tested. The work with varnishes has been limited in scope, but the materials used tended to make the paper surfaces somewhat sticky when warm and to increase the brittleness of the treated notes. Several nitrocellulose lacquers were tried, but these were generally considered to be impractical for large-scale application because of the strong and persistent odors of the solvents, which were of the type of amyl or butyl acetate, fusel oil, or similar materials. Objection was also raised to the excessively glossy surfaces imparted to the bills by the nitrocellulose lacquers used in the small-scale work.

With the co-operation of manufacturers of the materials, the possibility of using cellulose acetate as the protective material has been studied quite extensively. Many combinations of different cellulose acetates, plasticizers, and solvents were tested until there was developed a solution capable of imparting to printed surfaces improved resistance to oil, water, and wet rubbing, without noticeably decreasing the high

Do your figuring scientifically with the
RUXTON MULTI-VIDER
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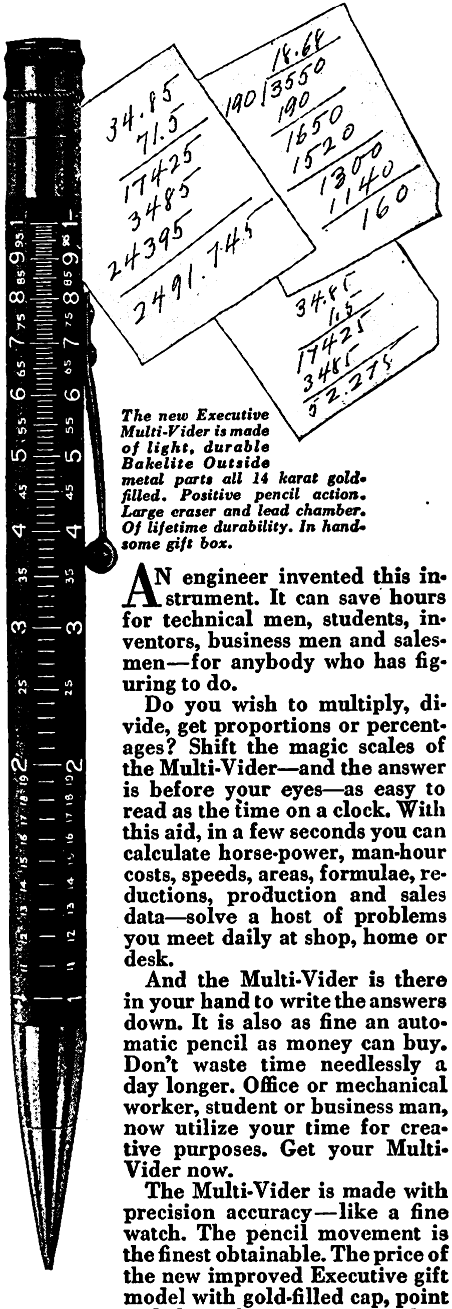

The new Executive Multi-Vider is made of light, durable Bakelite Outside metal parts all 14 karat gold-filled. Positive pencil action. Large eraser and lead chamber. Of lifetime durability. In handsome gift box.

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The Multi-Vider is made with precision accuracy—like a fine watch. The pencil movement is the finest obtainable. The price of the new improved Executive gift model with gold-filled cap, point and clip is $10.00—no more than you might pay for a high-grade automatic pencil alone. The serviceable Junior model, with outside metal parts in heavy silver plate, is $5.00. If your dealer doesn't have it yet, just mail the convenient coupon below.

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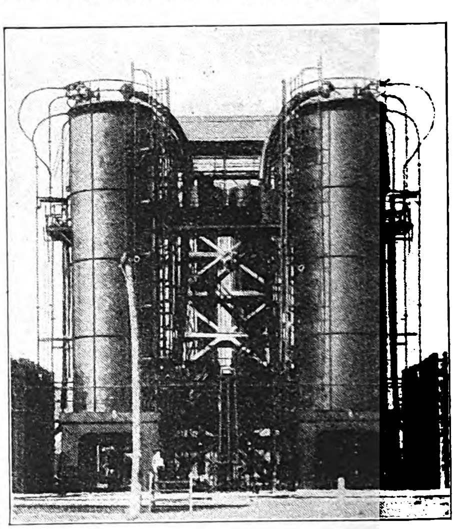
folding strength of the paper. The cellulose acetate forms a closely attached, invisible film that is free from gloss or stickiness and that does not bloom or discolor when dried at room temperature. Practical use of such a material would require special equipment for its application and for the removal of the organic solvents employed.

Soft Coal Smoke Costs Millions

"IT'S an ill wind that blows nobody good," and that goes even if the wind is laden with soot, for it means more business for the laundries. The pollution of the air by smoke from soft coal fires constitutes a serious evil, the magnitude of which is shown by data recently presented covering the situation in the city of Chicago and published in *Gas Age-Record.*

Considering fuel waste, extra washing and wear and tear of clothing, damage to textiles such as curtains and carpets, increased mortality and impairment of health, the annual loss in this city alone is estimated to be some 20,000,000 dollars. Taking the laundry item alone the average cost per person per year in Chicago is $3.25 as compared with two dollars in Philadelphia—or 50 percent higher.



Two units of a Dubbs process plant in an Oklahoma petroleum refinery, where gasoline is produced by the "liquid phase" process of "cracking" oils for higher yields

Carbon Dioxide Fire Extinguishers

ONE of the latest fire-fighting methods to be introduced depends upon the blanketing, stifling effect of carbon dioxide for extinguishing the flames. One of the large manufacturers of fire-fighting equipment is now offering a carbon dioxide fire fighting system known as Alfite, which employs liquid carbon dioxide in metal cylinders under a pressure of 900 to 1000 pounds. When the system is placed in operation, automatically, semi-automatically, or manually as the case may be, a plunger ruptures a copper disk which seals the cylinder and permits the gas to pass through piping to nozzles directed toward the fire.

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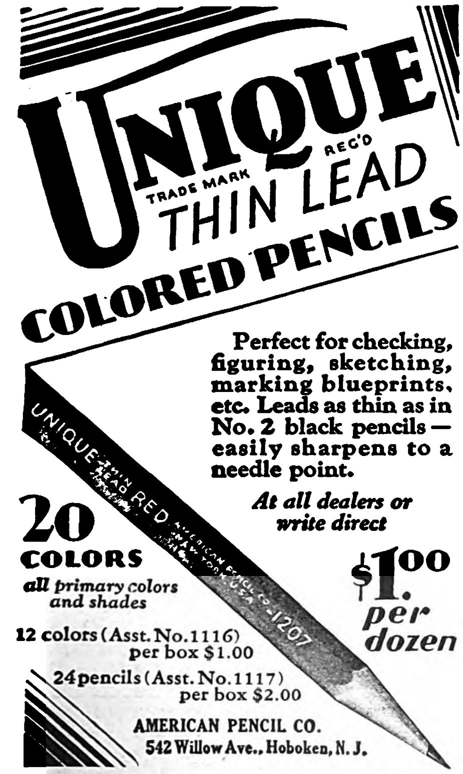
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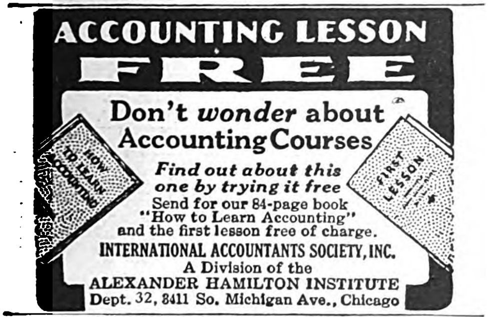

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Soap Dust Explosions Form New Industrial Hazard

SOAP is not generally considered dangerous to handle but tests made by the Pittsburgh Experimental Station of the United States Bureau of Mines, Department of Commerce have shown that certain types of soap-dusts, when suspended in air, are more violently explosible than most dusts encountered in industry. The well known "cooling" effect of sodium compounds on the flames of explosives and the "semi-inorganic" nature of the compound, soap, might lead one to expect soap-dust suspensions to be relatively non-explosible. Soap-dust suspensions in air are, however, easily ignited and produce violent explosions accompanied by much flame and large quantities of heat.

Light Alloys Perfected

LIGHT alloys and combinations such as aluminum-coated steel are coming into increasing prominence as the metallurgists seek to keep pace with the development of aviation and the demands of industry for lighter, stronger, corrosion resistant materials. "Silumin," for example, is a new aluminum alloy containing about 13 percent of silicon and valued for its light weight, high tenacity, and workability when heated. The metal Elektron, produced in Germany, has also proved its worth in place of high-grade steels for automotive purposes; it is a very workable and light magnesium alloy.

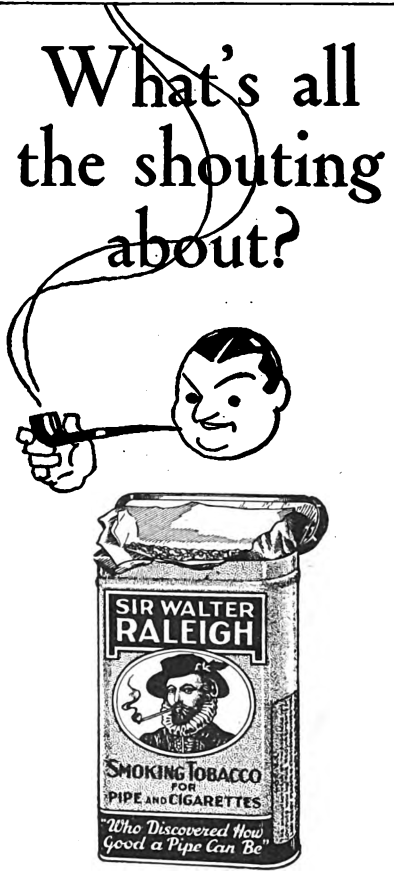
The aluminum alloys are now joined by the new Alautal which consists of a light steel with a thin coating of pure aluminum applied to it. Possessing great strength, a low specific gravity (2.75), and high chemical resistance, it is said to retain its aluminum coating firmly, however thinly applied.

Gasoline from Natural Gas

NINETY-TWO percent of all natural gas utilized last year was treated for the recovery of natural-gas gasoline, which consititutes the most valuable by-product of the gas industry, according to a recent article in the *Magazine of Wall Street.*

A large proportion of natural gas leaves the wells in a "wet" state, that is, it contains varying percentages of volatile gasoline vapors which can be "stripped" from it by absorption and condensation, leaving the gas in suitable condition for pipe line transmission and providing, in the "natural" gasoline, a valuable motor fuel. The high combustibility of this gasoline makes it particularly applicable to airplane motors with but slight modification, and by blending with lower grade gasoline derived from petroleum, a highly satisfactory motor fuel is produced.

From 350 to 1000 gallons are recovered per million feet of gas treated, or, in other words, from the 1206 billion cubic feet of natural gas treated in 1927, there were recovered 1363 million gallons of gasoline, At an average value of ten cents a gallon, this brought in a revenue of 136 million dollars, nearly half as much as the total revenue derived from the sale of natural gas itself in the same period.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The Scientific American Digest

(*Continued from page* 354)

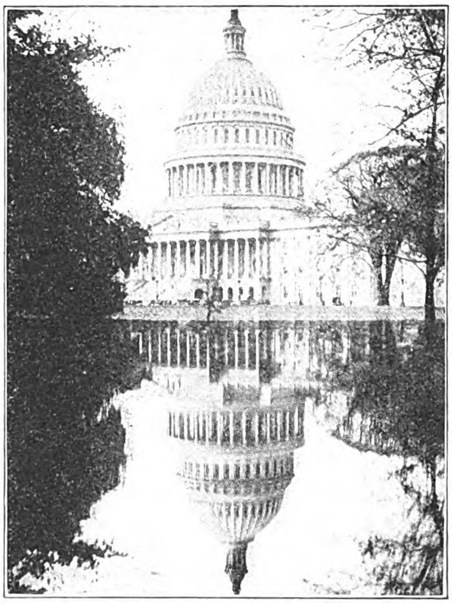
be now recognized as a standard method of writing, according to A. Tanakadate, member of the Imperial Academy of Japan, and member of the International Committee on Intellectual Co-operation. Important official documents, over 100,000 school books, and all the text books in technical schools and colleges are now using this type of letter.

Typewriters with key-boards arranged for writing Japanese with these characters are on sale and about 200 are now in use.

Professor Daniel Jones, eminent English linguist and phonetician, gives a full approbation to the Romanized Japanese system. The true function of Roman characters is to represent what Professor Jones calls diaphonemes; that is, certain groups of sounds peculiar to any particular language, and not the absolute individual sounds for which the international phonetic signs serve with sufficient approximation. —*Science Service.*

Photographic Reflections With Any Camera

THE average camera enthusiast is always looking for something new in the way of trick attachments for producing odd and unusual effects with his camera. We illustrate in these columns a novel reflecting attachment which may be used with any camera, and we also present an example of the work accomplished with the attachment.



What appears to be a lake before the Capitol is simply a photographic reflection made by a new device to be attached to a camera

Within the cone-shaped device shown, is a glass plate with a reflecting surface. This bisects the cone horizontally and the lower half of the mouth of the cone is covered. When a photograph is taken with this attachment in place, the upper half of the plate records the scene in the usual manner, whereas the lower half records a reflection which makes it appear that there is a body of water directly in front of the object photographed. By raising or lowering the camera, the extent of the apparent body of water may be varied.

This novel device was invented and

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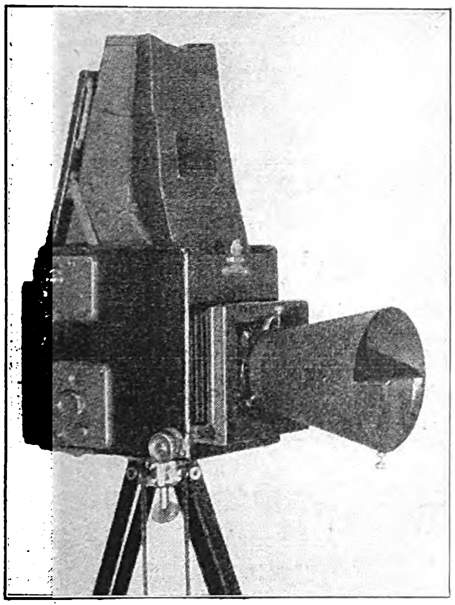
patented by Jack Sussman, a New York news photographer on the staff of Herbert Photos, Inc.

"Movie" Actors Skate on Hypo "Ice"

ICE-SKATING in the "movie" dramas isn't done on ice at all. The Hollywood climate is too balmy. Chemists have come to the rescue, and photographers' "hypo" has been substituted for the ice.

For example, the motion-picture director is desirous of staging a supposed Canadian championship skating tournament. Following the suggestion of Professor Arthur R. Maas, industrial chemist of the University of Southern California, he now buys a ton or two of hypo. The chemical is spread about the premises, groomed with a hot iron, cooled, and is ready for the skaters. All of the fancy stunts done on ice seem equally well performed on hypo, and the movie patron doesn't know the difference.



Camera with the device which made the picture on opposite page

Hypo is known to chemists as a compound of sodium thiosulfate with a considerable quantity of water. At normal temperatures it is a dry, glassy, but somewhat soft solid of much the same texture as ice. Unlike ice, however, it melts at 118 degrees instead of 32. At the elevated temperature it dissolves in its own water of crystallization, and is easily applied to the surface which is to represent a frozen lake.

Under the pressure of the running skate, hypo is scored much as ice. Semi-transparent flakes and grains fly into the air during the course of the movie drama. Under the eye of the camera the delusion is almost perfect. At the end of the day, a gentle sprinkling, followed by a hot iron, restores the fake ice to its pristine luster.

The use of the crystalline thiosulfate has been proposed for amusement rinks, but would likely have too stiff a competition from artificial ice as now employed. On the vaudeville stage, as well as in the "movies," it has been successful. It is possible that some new and cheaper material of moderately high melting point may be brought forth to displace ice, thus eliminating the high cost of refrigeration.—*Science Service.*

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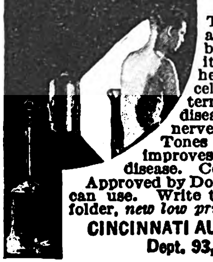
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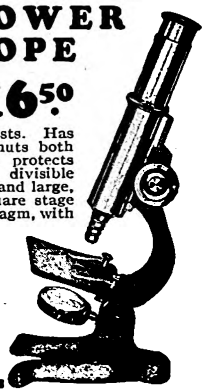
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EDISON recently said to reporters: "When a boy around 15 or 16 is found trying all kinds of experiments he shows ambition and the will to work. This boy is safe for a good career." Norman Lockyer was such a boy and his career turned out exactly according to Edison. Earning his living as a War Office clerk but devoting every spare moment to amateur astronomy he finally became Britain's most noted solar physicist, discovered helium in the sun's spectrum decades before it was found on earth, founded and for 50 years edited *Nature*, foremost English journal of science, was knighted and honored, but always retained that enthusiastic spirit that keeps the typical amateur scientist at work—"because he cannot help it." This piece of biography is romance, true romance—a book that should inspire any ambitious youth to emulation. It is not, however, a youth's book—rather, it is one you will yourself read before you present it to that lad you like to imagine as a future scientist. $7.45 postpaid.

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Charles G. Abbot; Secretary, Smithsonian Institution

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RECENT interest in the author's polar flights arouses curiosity concerning his previous experiences. In this work we find a brief account of his expedition to tropical Australia during 1923–25 to collect specimens of the rarer native fauna for the British Museum. It is also a well told tale of unique and dangerous experiences. $4.70 postpaid.

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For Sale by SCIENTIFIC AMERICAN

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

"Plymouth" Is "Merely Geographical"

THE Plymouth Motor Corporation, of Detroit, is not entitled to register as a trademark for automobiles and structural parts thereof, a mark consisting of a rectangular panel containing the picture of a ship, with the words "Chrysler Plymouth" beneath, unless the word "Plymouth" be disclaimed. In his ruling to this effect, First Assistant Commissioner Kinnan held that "to the average person in this country the word 'Plymouth,' as used in the applicant's trademark, is merely geographical in its significance."

The applicant argued that the word is not merely geographical but indicates a historical event, and also that there exists a religious sect known as the "Plymouth Brethren," and a breed of chickens known as "Plymouth Rocks."

In his denial of the application, the First Assistant Commissioner stated that there is no denial of the fact that "Plymouth" is the name of an English city, and is a common geographical name in the United States. Under the present ruling, it is made clear that anyone manufacturing automobiles in Plymouth, Massachusetts, or any other town in the country which bears this name, is entitled to designate such automobiles by the name "Plymouth."

Oil Company Wins "Parco" Decision

THE privilege of using the word "Parco" to represent rust-proofing material is held by the Producers and Refiners Corporation, of Denver, Colorado. Application of the Parker Rust-Proof Company, of Detroit, Michigan, to register as a trademark for rustproofing material a mark consisting of the words "Parco Powder," has been denied by Assistant Commissioner Moore.

The opposer, the Producers and Refiners Corporation, had used the words "Parco Petroleum Products," arranged one beneath the other, with a single initial letter, the whole surrounded by a polygonal outline, as a trademark for gasoline, kerosene, and by-products thereof, especially rustproofing materials. The Parker Rust-Proof Company sought to register as a trademark for rustproofing material a mark consisting of the words "Parco Powder," arranged one beneath the other and surrounded by a diamond shaped outline.

Assistant Commissioner Moore ruled that the trademark should be denied because the marks are substantially identical and the goods of the same descriptive qualities. Both parties adopted the word "Parco" as the essential and dominating characteristic of their trademarks. The word "Powder" occuring in the applicant's mark, and the words "Petroleum Products" occuring in the opposer's mark, were disclaimed by the parties apart from their respective marks.

The difference of form of the border line was held to have no material bearing on the question of whether the two marks were confusingly similar.

With respect to the goods, the Assistant Commissioner noted that both are rustproofing materials, and said, "The applicant points out that its rustproofing material is a powder, whereas the opposer's goods do not have this property. This fact, however, does not justify the registration of the same mark by different parties where the goods of both parties are rustproofing materials. In use the applicant's material is in a liquid state. It is admitted that in its advertisements it is stated that Parco powder is an inert dry chemical which added to a tank of boiling water forms the rustproofing bath.

"It may be true that they differ from each other as to their specific composition and action on the metals, but both possess the essential rustproofing property, and when sold under the same trademark the natural inference would be that they came from the same source or have common ownership."

New York Is a State of Mind

WORDS which are geographical are not registrable in the Patent Office as trademarks. Nevertheless, it was with perfect confidence that the Levin and Harris Shirt Company sought to register "The New Yorker," written across the general outline of a tower, as a trademark for men's and boys' shirts.

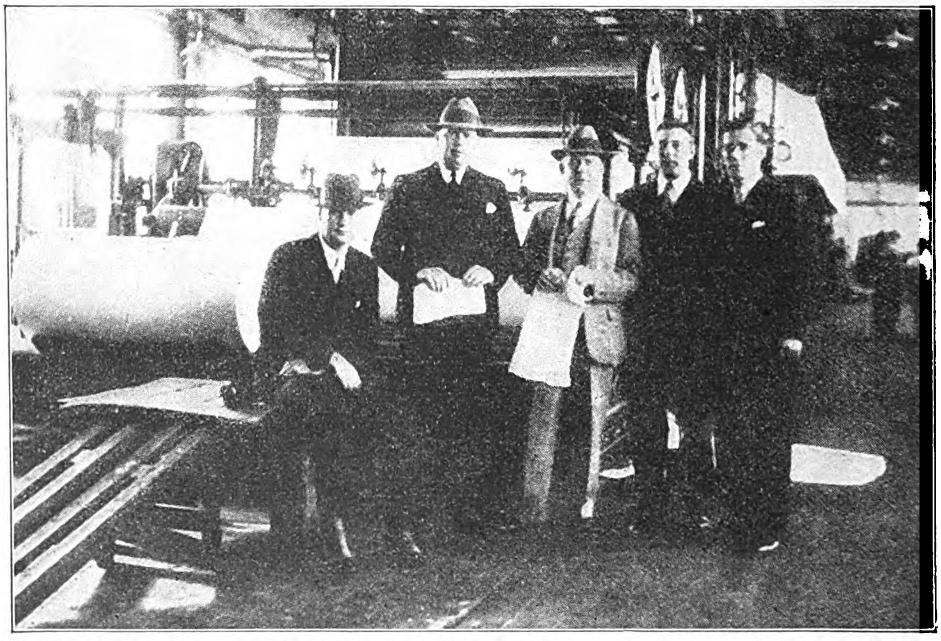
When the application was taken on appeal to Assistant Patent Commissioner Moore, he based his ruling largely on a decision of the Supreme Court holding that the trademark "American Girl" for shoes is not geographical.

"The terms 'American Girl' and 'New Yorker' are commonly employed to designate, respectively, a girl whose habitat is in America, or one whose habitat is in New York," said Assistant Commissioner Moore. "They have reference to a person, and do not in any sense have a geographical or descriptive signification with respect to the merchandise with which the terms are associated in trade. They do not signify that the merchandise is manufactured in America, generally, or in New York, specifically; nor do they indicate the quality or characteristics of the merchandise. They are fanciful terms arbitrarily selected to designate the manufacturers or owners of the respective articles of merchandise to which they are appropriated.

"In view of the above I am of the opinion that the appellant's trademark is registrable, and that the requirement that the words 'The New Yorker' be disclaimed should not be insisted upon. The decision of the examiner of trademarks is reversed."

Collars and Collar Buttons

EVERYBODY who reads advertisements knows of "Arrow" collars. So much money has been spent in popularizing the name and so many millions of collars have been made and sold over so long a time that there is little doubt that Cluett, Peabody and Company, of Troy, New York, have exclusive title to the trademark for collars and for shirts as well. It is well settled that registration of a mark covers not only the particular article of merchandise for which it may be used, but for all other articles having the same descriptive properties.



Bond paper from cornstalks is produced in this paper plant at Taylorville, Illinois. It has been found that a mixture composed of 70 percent cornstalk pulp and 30 percent wood pulp will yield an excellent quality paper. The picture shows officials of the paper company inspecting their new product

But how about the collar buttons which hold the shirts and collars together? Since suspenders have been held to be of the same descriptive properties as shirts and underwear, surely collar buttons would fall in the class with collars. So reasoned Cluett, Peabody and Company, and sought to cancel the registration of the trademark "Arrow" registered for collar buttons by the Arrow Emblem Company. First Assistant Patent Commissioner Kinnan, however, held otherwise.

"Since collar buttons are used solely to hold the collars or the shirts in place," he said, "they, like garters or suspenders, are wearing apparel and are goods having the same descriptive properties. The fact can not be overlooked, however, that collar buttons are generally made of metal, and this is specifically true of the registrant's goods, and metal working is not usually done in the same factories which would make the collars or shirts. There is a wider distinction in the mind of the purchasing public between metal goods of the kind here being considered and woven or knitted fabrics made into garments and collars as are the petitioner's goods. There is an inherent difference that would not be readily overlooked by purchasers notwithstanding the fact, fairly established by the testimony, that both classes of goods are sold by haberdashers and are included in the general term 'men's furnishings.' "

Putting Ideas to Work

NEW "wrinkles" to meet the needs and problems of everyday life too frequently never materialize. In industry it has been found that a good method of putting ideas to work is to encourage each employee to apply his knowledge, whether gained through study or practical experience, toward developing a better solution to some of the problems of his job.

Not long ago, the Hope Natural Gas Company formed a "Coin Your Ideas Committee" for this purpose, according to a recent article in the "Wrinkle Department" of *Natural Gas*. One of the problems in the gas industry was due to moisture freezing in the mercury float of the orifice meter, one of the most important measuring devices used by gas companies. Expert meter men had tried for years to find a practical way to prevent the trouble, but with each recurrence of cold weather, the moisture would collect and freeze, requiring the attention of skilled repairmen.

Glenn Frum, a young man employed in the West Virginia gas fields of the Hope Natural Gas Company, saw that the best way to eliminate this expensive nuisance was to dehydrate the gas. This meant finding some practical means of extracting the moisture before it reached the float. This he did, simply by using a drying tube, such as may be found in the laboratory of any chemist.

By attaching the glass tube filled with anhydrous calcium chloride to the meter inlet, the moisture in the gas is effectively absorbed. Using this device, an orifice meter can be left in service at least three weeks before the chemical must be replaced. Formerly it was necessary to remove the accumulated moisture at least every 48 hours during cold weather.

Frum's "wrinkle" was quickly appreciated by his employers. A patent was applied for and obtained, arrangements were made with the Metric Metal Works to manufacture the Frum De-Hydrating Tube, and Glenn Frum, the young man who coined the idea, receives a royalty on every tube sold.

End-Matched Boards

THE place of the United States Army in the field of invention is one that often is overlooked. Nevertheless, the Army is constantly at work perfecting new methods and new devices which are useful not only in warfare, but in peacetime industries. Who would expect, for example, that it would be in the War Department that there would develop a new type of wooden flooring that would effect a cost saving of 30 percent. Yet that is precisely what the Quartermaster Corps has reported to the National Committee on Wood Utilization.

In co-operation with the Committee, Major W. H. Danielson, Q. M. C., Chief of Maintenance and Operation, has been working out wood utilization practices for army requirements. A new kind of soft-wood flooring has been worked out which differs from the usual type in that one end of each piece is provided with a tongue and the other end with a groove. In this manner, lumber of any length, from two feet up, can be successfully used in floor construction, there being no need of cutting back the flooring strips to the next joist, since the joints may occur between supports.

Such a floor is easily and quickly laid and the saving in both time and labor usually varies from 20 to 30 percent, and even more. In addition, one does not find any flooring ends lying around the building job in cases where end-matched lumber is used.

Considering that soft-wood flooring in Washington today is worth in excess of 100 dollars per thousand feet, it is easily seen that it does not require much of an accumulation of flooring ends to run into money.

"Pullman" Bags and Pullman Cars

WHEN the public sees the word "Pullman" applied to an article, it assumes that the article is a part of the service identified with a certain type of railroad car known by the name of Pullman. This reason, coupled with the fact

Patents Recently Issued

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Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

SHOE ARCH SUPPORT—Comprising a plurality of superposed arch supporting springs, normally bowed, but which may be adjusted as desirable or necessary, for properly resting the foot of the wearer. Patent 1698635. Thomas H. Joyce, 2413 Cropsey Ave., Brooklyn, N. Y.

SHOE COUNTER—So formed that the counter will hug the last snugly at all points, including the upper edge at the back of the heel portion of the last. Patent 1699474. Frank L. Mason and Antonio Gagliardi, 1087 East 3rd St., Brooklyn, N. Y.

UNDERGARMENT—Which permits of the use of freely moving non-elastic shoulder straps, but having elastic means normally hidden by the garment, particularly adapted for brassieres and the like. Patent 1699923. Anna Rothstein, 4911 No. Bernard St., Chicago, Ill.

Chemical Processes

PROCESS FOR RECOVERING OILS FROM EMULSIONS—Comprising thoroughly mixing metallic sodium and calcium carbide with the emulsion to cause chemical reaction, whereby the water and oil are separated into strata. Patent 1700627. Samuel W. Cole, Box 1266, Beggs, Okla.

Designs

DESIGN FOR A SLIPPER BODY—Patent 77448. Herman Wilhelm, c/o Bernard Bernbaum, 1440 Broadway, New York, N. Y.

DESIGN FOR A DRESS—Patent 77557. Dorothy M. Long, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A RADIO CABINET—Patent 77595. Harry J. Frenz, 3449 Rorer St., Philadelphia, Pa.

Electrical Devices

SADIRON—An electrical heating unit by which steam can be generated as desired and applied to the garment during the normal pressing operation of the iron. Patent 1697224. Louis S. Butman, 1087 West Ocean Ave., Long Beach, Calif.

FLASH LIGHT—Capable of being readily positioned on a horizontal support, and its lamp housing adjusted laterally, thus eliminating holding the lamp to secure the desired rays. Patent 1699927. Merle M. Stearns, 225 Barnett St., Ventura, Calif.

RADIO RECEIVING CIRCUIT—Which will operate a loud speaker, is capable of picking up distant transmitting stations, and which can be operated at a minimum cost. Patent 1700652. Christian K. Schenck, 422 W. 115 St., New York, N. Y.

Of General Interest

KITCHEN-UTENSIL SUPPORTER—Having a plurality of supporting hooks and recesses so arranged that a maximum of space, and supporting means are provided for articles in a relatively small device. Patent 1697711. Arthur Brown, Grand Ave and Babylon Turnpike, Freeport, L. I., N. Y.

PASTRY MIXER—Comprising two similarly formed elements of sheet metal, each having raised rubbing members for effectively gripping the pastry dough and causing the same to be thoroughly worked. Patent 1697837. James M. Sudduth, 319 Madison Ave., Pierre, S. D.

SLIDING DOOR—In which a plurality of sections flexibly united may be readily shifted on a turn, and which will insure against leakage when the door is closed. Patent 1697772. James A. Lewis, 59 Summit St., Newton, Mass.

Fastening Device—Employing a stationary arm and a movable arm, and means for preventing the rotation of the fastening device after it has been inserted in a fabric or other article, thereby producing a device which cannot be accidentally removed. The inventor has been granted two patents, 1696284 and 1696285. Frederick C. Rile, 6022 Calumet Ave., Chicago, Ill.

Comb—In which the teeth are provided with absorbent pads which may be gently run over the scalp, for the application of an oil, or tonic to the hair. Patent 1698631. Harry H. Hutchings, 220 W. 42nd St., New York, N. Y.

Oil Can—Including a pump assemblage, a piston rod extending through the top of the can and means for limiting the piston stroke, and a discharge tube and nozzle. Patent 1698632. Fred I. Jaden, Hastings, Neb.

Sliding Door—Which will require but little manual effort to raise or lower, thus rendering the door particularly applicable to crowded structures where it is impossible to employ swinging doors. Patent 1698675. Thomas H. Cromer, Box 550, Greenville, S. C.

Stocking Frame—Constructed to adjustably accommodate stockings of different sizes and kinds, especially silk, and to maintain the stocking in proper shape, while drying, after being washed. Patent 1697968. Gene G. Beckhardt, 475 17th St., Brooklyn, N. Y.

Bag Lock—Including flanges and prongs which coact with means for releasably holding the buckle clasp of a hand bag, pocketbook or brief case, in adjustable position. Patent 1698657. Daniel I. Reiter, 142 5th Ave., New York, N. Y.

Card Case—In which business or calling cards can be kept, carried, and protected against being soiled, yet can be singly projected from the case and thus readily withdrawn. Patent 1697266. Raymond J. Opfergelt, 115 W. 64th Place, Inglewood, Calif.

Wall Wires—For use in cement wall construction, for holding the forms, the wires are previously shaped, and may be easily withdrawn and the holes made water tight. Patent 1697354. Karl O. Gober, 3025 Richmond Blvd., Oakland, Calif.

Road Map—Of a size which may be conveniently held and manipulated by one hand, the leaves being turned by the thumb for easy consultation, while the vehicle is under way. Patent 1697350. William C. Eubank, 1002 Santa Fe Bldg., San Francisco, Calif.

Hose Coupling—Especially adapted to garden or fire hose, may be firmly secured to a faucet, and has novel means for securing the sections to provide leak-proof joints. Patent 1698195. Victor Karbowski, c/o Rev. F. S. Feldheim, 1534 Wilder St., Evanston, Ill.

Advertising Novelty—Which includes telescopically slidable elements upon which figures and scenes are printed, the scenes and figures being simultaneously exposed with projection and display of the elements. Patent 1699383. Reuben Le G. Taylor, c/o Blanchard Press, 418 W. 25th St., New York, N. Y.

Book Rack—A substantial rack, supported from a bed rail and readily adjustable for holding a book, magazine or the like in open position convenient for reading. Patent 1699176. Adolph E. Zaremba, 2021 Milan Ave., South Pasadena, Calif.

Combined Hinge, Compact Plate Holder and Ejector—Formed of wire bent to extend beneath the compact plate and then into a position for acting as a pintle for the hinge of a vanity case. Patent 1700059. William G. Kendall, 118 Market St., Newark, N. J.

Clothesline-Supporting Means—For what are commonly termed "endless pulley lines," which admits of the full use of the clothesline for support, precludes displacement, and permitting tensioning of the line. Patent 1699630. John T. Pilkington, Hotel St. Claire, Detroit, Mich.

that it is clearly the name of an individual and is also a geographical name in Illinois, was cited by Assistant Commissioner Moore in his decision holding that the F. H. White Company, of Philadelphia, is not entitled to register the name "Pullman" as a trademark for traveling bags and suitcases.

In his decision, Assistant Commissioner Moore pointed out the prohibition against the registration of names of individuals and corporations, unless written in a particular manner, and noted the applicant's argument that the dominating significance of the term is a certain well-known type of railroad car.

"I am of the opinion that the registration of the mark should be denied on either of the statutory grounds above named," he said. "It is clearly the name of an individual, also, of the Pullman firm or corporation, and is not written, printed or impressed in any distinctive manner. It is also the geographical name of the place in Illinois where the Pullman sleeping car and palace car are manufactured.

"To apply the word 'Pullman' to traveling bags and suit cases indicates to the public that such bags and suit cases are part of the Pullman service."

The American Beauty Contest

When Joseph W. Sheridan, of Quincy, Illinois, sought to register as a trademark for ice cream cones a mark consisting of the words "The American Beauty Rose" arranged in a shield shaped border with a picture of a rose on one side, strenuous objection was made by the National Biscuit Company. The biscuit company is the owner of a trademark consisting of the words "American Beauty" and a picture of two roses as a trademark for crackers and biscuits. The new mark, they protested, was closely similar to theirs.

First Assistant Commissioner Moore agreed with them. Nevertheless he permitted the registration on wholly different grounds. He found that ice cream cones and crackers are made of the same material, and, in some cases, are made by the same manufacturers, but that despite this, there was little likelihood that confusion would result.

"It must be understood," he said, "that the opposer (the National Biscuit Company) sells its goods in small packages and they reach the ultimate consumer, as a general rule, in such packages. On the other hand, the applicant sells his ice-cream cones to the ultimate consumer one at a time and not as a separate commodity, but as a receptacle for the ice cream sold with it. The consumer may be said never to ask for the applicant's goods apart from the ice cream, but substantially always to ask for the ice cream and to receive the container as an incident of the purchase.

"It has not been overlooked that the opposer has shown its goods are sold in packages to druggists and dispensers of confections and ice cream and that such merchants or dispensers buy the applicant's product in small packages or cartons. Such purchasers, however, are of a character that would be less likely to be misled by the similarities of the mark upon these specifically different goods. They are not of the class wherein the class of purchasers was stated to be persons unable to read, including children, servants, foreigners, and uneducated persons, as well as those ordering the goods over the telephone."

Police Club—Having laterally projecting spurs, normally protected within the surface but movable to active position for puncturing an automobile tire, dragging objects from a river or other necessary uses. Patent 1700023. Jacob D. Capriles, 30 Prinsenstraat, Curacao, Dutch West Indies.

Building Construction—By means of blocks, which are fireproof and non-conductors of heat, may be readily assembled or taken apart, and will form a building readily heated. Patent 1699651. Lewis C. Bennett, 5807 Blackstone Ave, Chicago, Ill.

Liquid Container—Formed flat throughout and divided interiorly into a plurality of independent compartments with an independent outlet for each compartment and removable closure for each outlet. Patent 1700623. Etta M. Bleecker, c/o Miss E. M. Squies, Amityville, L. I., N. Y.

Massage Apparatus—Having handles at its ends and roller elements at its intermediate portions, can be conveniently washed with soap and water without injury, having no metal parts to rust. Patent 1700633. Abram A. Hendrickson, Prospect Ave., Oradell, N. J.

Flood-Tide and Backwater Valve—For preventing backwater from entering a cellar, affording a maximum clearance for the escape of foreign matter, and the prevention of valve closing. Patent 1700636. Albert M. Khun, 120 Union St., Elizabeth, N. J.

Bag Holder—A metal strip, so bent to form that it will provide greater facilities for the insertion, retention and dispensing of bags used generally in retail stores, may be easily supported. Patent 1700641. Jack Medlock, Grandfield, Okla.

Hardware and Tools

Device for Cutting Glass—By means of which, one who is not particularly skilled in glass cutting may make a clean cut along a perfectly straight line with an ordinary glass cutter. Patent 1697044. Joseph Burda, 2743 Southport Ave., Chicago, Ill.

Cheese-Curd Knife—Combining two standard types of knives in one, whereby the operator can cut a cheese into cubes by moving the knife across the length and width of the vat. Patent 1695761. John H. Hecker, c/o Douglas Cheese Asso., Gardnerville, Nevada.

Wrench—The fixed jaws having an opening of general egg-shape, the movable jaws having opposed angular faces, which may be easily adjusted and secured. Patent 1697764. Peter M. Heinz, 350 Grandview Ave., Dubuque, Iowa.

Padlock—In which the shackle is arranged to be entirely removed from the cooperating body portion of the lock, and a simple means employed for locking the core in position. Patent 1698201. Joseph Pietrie, 2219 Iowa St., Chicago, Ill.

Double Bull Hook—With means for readily connecting the ends of a plurality of ropes in such manner that they will be firmly held against disengagement during variations of the pull. Patent 1699381. Stanley B. Stewart, 220 So. King St., Centralia, Wash.

Hack-Saw Frame—Of telescopic and adjustable form, in order that the depth may be varied to accommodate a deeper cut, and adjustable to accommodate blades of various lengths. Patent 1699291. Samuel W. Halbert, 518 So. Tremont St., Los Angeles, Calif.

Drill Bit—For well drilling, particularly adapted for soft formations, constructed to clear the hole as it goes, permitting the pipe to follow, and drills with great rapidity. Patent 1698873. Ralph K. Burke, 225 Oxford Ave., Lindsay, Calif.

Valve—For quickly coupling female and male members with the end of a globe valve casing, and controling the water supply to a hose or other conduit. Patent 1700073. William H. Parker and Charles A. Taylor, 330 Clarkson St., Denver, Colo.

Safety Device for Gas Cocks—Automatically operable to keep the cock closed and prevent unintentional flow of gas, but readily operated to permit intentional flow, may be easily associated with a gas cock. Patent 1700063. Max Krueger, 36 Thames St., Brooklyn, N. Y.

Hose Clamp—Comprising wire coils formed in such manner that the wire extends completely around the hose thereby leaving no open spot at which a leak may occur. Patent 1700043. Fred W. Gunn, 318 Columbus Ave., Boston, Mass.

Boring Tool—In which an auger bit associated with a pair of milling cutters, will drill a square opening, leaving only a pair of small fillets for removal by hand. Patent 1700654. Fred R. Stelzenmuller, Box 127, River Road, Delawanna, N. J.

Heating and Lighting

Method of and Apparatus for Drying Combustible Materials—By a furnace, and a revolving drum, whereby the moisture of lignite coal, as it comes from the mine, is reduced to about 15%, best adapted for combustion. Patent 1697268. Hansen Evesmith, c/o Scranton Collieries Corp., Scranton, North Dakota.

Oil Stove—With means for facilitating the lighting of the principal wick, by merely turning on the main wick oil supply, a continuous pilot light being used for ignition purposes. Patent 1699411. Chris M. Thomsen, c/o E. J. Burnham, 836 Huntington Blvd, Pomona, Calif.

Machines and Mechanical Devices

Key - Duplicating Machine — Having specially formed work and pattern holding clamps, for securing a cylinder key and a blank, while the blank is being cut to reproduce the pattern. Patent 1697747. Frederick A. Bachman, 268 Summit St., Union City, N. J.

Separator—In the form of a dust collector, for use in separating, in an efficient and clean manner pulverulent, powdered, or finely comminuted solids from air laden therewith. Patent 1697743. George C. Webster, c/o Davidson & Forsythe, 436 Barrington St., Halifax, N. S., Canada.

Device for Reducing the Skin and Wave Resistance of Moving Boats—A compressed fluid apparatus, for discharging air jets over the hull at points of greatest resistance to the water, thus permitting the boat to attain a greater speed. Patent 1697257. Boris Anissimoff, Box 1052, Manila, Philippine Islands.

Manufacture of Die Castings—Comprising a mold and a fluid actuated plunger which recedes under the action of fluid entering the mold, thus eliminating blow holes, especially in thick castings. Patent 1697741. Conrad Vaughan, c/o Forrester, Kelley & Co., Attrs., Birmingham, England.

Textile-Finishing Machine—Wherein feeding drums are so mounted with relation to the finishing rollers as to facilitate the operation of rubbing the textile, to impart a high luster. Patent 1697736. Frederick W. P. Rose and Christian Werner, c/o Werner & Co., 183 Autumn St., Passaic, N. J.

Device Insuring in a Continuous and Automatic Manner the Synchronism Between a Gramophone and a Cinematographic Projection Machine—For the purpose of giving the phonetical reproduction accompanied by the optical reproduction of a moving picture. Patent 1697695. Luigi Robimarga, c/o Letterio Laboccetta, Via Due Marcelli 31, Rome, Italy.

Safety Device for Extractors—For preventing the opening of the cover of a laundry machine while the working parts are in operation, or starting the machine while the cover is open. Patent 1697798. Charles W. Terwilliger, 476 Eastern Parkway, Brooklyn, N. Y.

Dry-Cleaning Apparatus—A compact device which may be manually or mechanically operated and controlled, which will reduce to a minimum the loss of non-explosive cleansing fluid, permitting the fluid to be used over and over again. The inventor has been granted two patents, 1697766 and 1697767. Maurice DeW. Hirst, 1612 Market St., Philadelphia, Pa.

Vending Machine for Stationery—For discharging by gravity sheets of writing paper simultaneously with a stamped envelope, upon the insertion of a coin of predetermined size. Patent 1698644. John H. McCutchen, 1 So. Main St., Memphis, Tenn.

Casting Machine—Particularly adapted for making dental castings of metal, porcelain, or suitable material for inlays, backings, dummies, crowns, bridges, plates, regulating appliances and the like. Patent 1698197. John A. Lentz, 117 East Palm Lane, Phoenix, Arizona.

Slug Magazine for Extruding Machines—Whereby slugs are accurately positioned to be regularly fed into the machine, and are resiliently clamped to prevent them entering the magazine in an improper manner. Patent 1699504. Frank J. Lynch, c/o Sun Tube Corp., Hillside, N. J.

Deep-Well Pump—Adapted to automatically take up wear between the plunger and the cylinder wall, and prevent sand from becoming lodged between the plunger and barrel, whereby leakage is prevented. Patent 1699036. Ralph B. Welsh, Box 299, Burkburnett, Texas.

Return Trap—For installation in steam systems for receiving and returning the water of condensation to the boiler, all the working parts being housed for eliminating air from the system. Patent 1699464. Charles H. Dutcher, c/o Kieley & Muller, Inc., 34 W. 13th St., New York, N. Y.

Lard-Refining Device—Comprising a receptacle in which the refining is more thorough, uniform, and more rapid, with less manual labor, and which obviated the need of using crushed ice. Patent 1698756. James S. Hunter, 37 No. Halsted St., Chicago, Ill.

Selector Mechanism for Pleating Machines—For rendering one of the pleating knives inoperative upon any desired stroke of the machine in order that straight, box or other types of pleating may be produced. Patent 1699340. Louis Angelus, c/o Circle Pleating Machinery Co., 625 6th Ave., New York, N. Y.

Signaling Device for Machines—Adapted to warn the operator of a machine each time one of the parts attains the limit of function, the limit being determined in advance for the several elements. Patent 1700068. Henri Meurin, c/o C. Bletry, 2 Boulevard de Strasbourg, Paris, France.

Rotary-Shaft Lock—Which prevents rotation of the shaft except by movement of a driving member, which produces a torque on said shaft, particularly suited for use on dumb-waiters. Patent 1700049. Richard R. Haupt, Jr., and Walter F. Haupt, 652 High St., Newark, N. J.

Tunneling Device—Adapted to bore holes in the ground beneath streets, houses or the like for laying pipes without injury in any way to the structure above. Patent 1699936. Henry M. Watchorn, 217 So. Popular St., Sapulpa, Okla.

Trigger Mechanism for Firearms—Whereby a military rifle can be discharged with but relatively light finger pressure, disturbing the marksman's aim obviated, and the rifle rendered adaptable for sportsman's use. Patent 1699881. Francis K. Elliott, 354 West Ave. 45, Los Angeles, Cal.

Apparatus for Tempering Sole Leather—Wherein the leather stock will be held separated, submerged in water for a predetermined period, removed, enclosed, and shut off circulating air, to obtain a complete saturation. Patent 1700653. Charles Shaw, 6430 Woodbine St., Brooklyn, N. Y.

Medical Devices

Sanitary Shield—Of transparent material, will effectively shield the eyes, nose and mouth of an operator, and is adapted to be readily supported from the ears, eyeglasses, or an opthalmoscope. Patent 1697733. William A. Poole, McClelland Bldg., Lexington, Ky.

Obstetrical Instrument—Embodying a pair of separable handles and a flexible loop, which after being correctly positioned about the infants head, may be maintained under tension, and manipulated with one hand. Patent 1690942. Edwin O'Dell, Central City, Nebraska.

Sheep-Dosing Device—A syringe for administering liquids, having a rigid tube, and a resilient tube, large enough and sufficiently rigid to prevent doubling, yet small enough for use on lambs. Patent 1699590. Joseph W. Ireland, c/o Noorman Mfg. Co., Chicago, Ill.

Musical Devices

Collapsible Stringed Instrument—A practice instrument, which will have the natural feel of a regular instrument, and may be played in an apartment without annoyance to occupants of neighboring apartments. Patent 1699384. Livingston Welch, 229 E. 79th St., New York, N. Y.

Combination Magnet and Primary Valve—A unit in which the primary valve and the electromagnet for actuating it, are so combined as to control the flow of air in a pipe organ. Patent 1699363. August A. Klann, Park Station, Waynesboro, Va.

Prime Movers and Their Accessories

Spark-Plug Tester—Which may be employed to test the spark under substantially the same degree of compression as it will be subjected to in practice, thereby readily indicating defects. Patent 1700026. Carman S. Cole, c/o Naval Air Station, Anacostia, D. C.

Railways and Their Accessories

Air-Brake Lever Mechanism—For use on railway cars, and other vehicles, wherein a cushioned effect is given the braking action, and a maximum leverage secured with a minimum use of air. Patent 1698656. Angstadt B. Ream, 722 So. Market St., Elizabethtown, Pa.

Safety and Service Value—Equipped with automatically acting means for preventing the escape of steam, if a main valve or its casting becomes accidentally broken, particularly adapted for steam locomotives. Patent 1698616. Raybon C. Woodham, 518 Clayton St., Montgomery, Ala.

Rail-Joint Fastener—Which affords facilities for securely connecting the end portions of two rails and holding them against sagging, twisting or rattling, also serving to guard the electrical bond wire. Patent 1700046. George W. Harlan, Otterville, Missouri.

Pertaining to Recreation

Amusement Apparatus—Which gives the impression of driving an automobile over a course having straight and curved portions, and requires some skill to prevent bumping against the side rails. Patent 1700640. William F. Mangels, 2875 W. 8th St., Coney Island, N. Y.

Pertaining to Vehicles

Controlling Device for Power Transmission for Vehicles Traveling upon Tracks—Characterized by electric motors whose axes are situated in parallel verticle planes oblique to the longitudinal axis of the vehicle, and acting upon the axles near their middle. Patent 1697730. Pierre Mariage, c/o Office Picard, 97 Rue St., Lazare, Paris, France.

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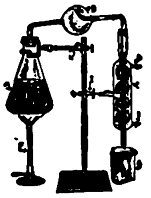

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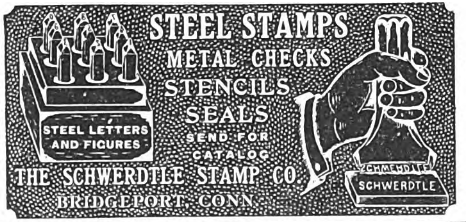

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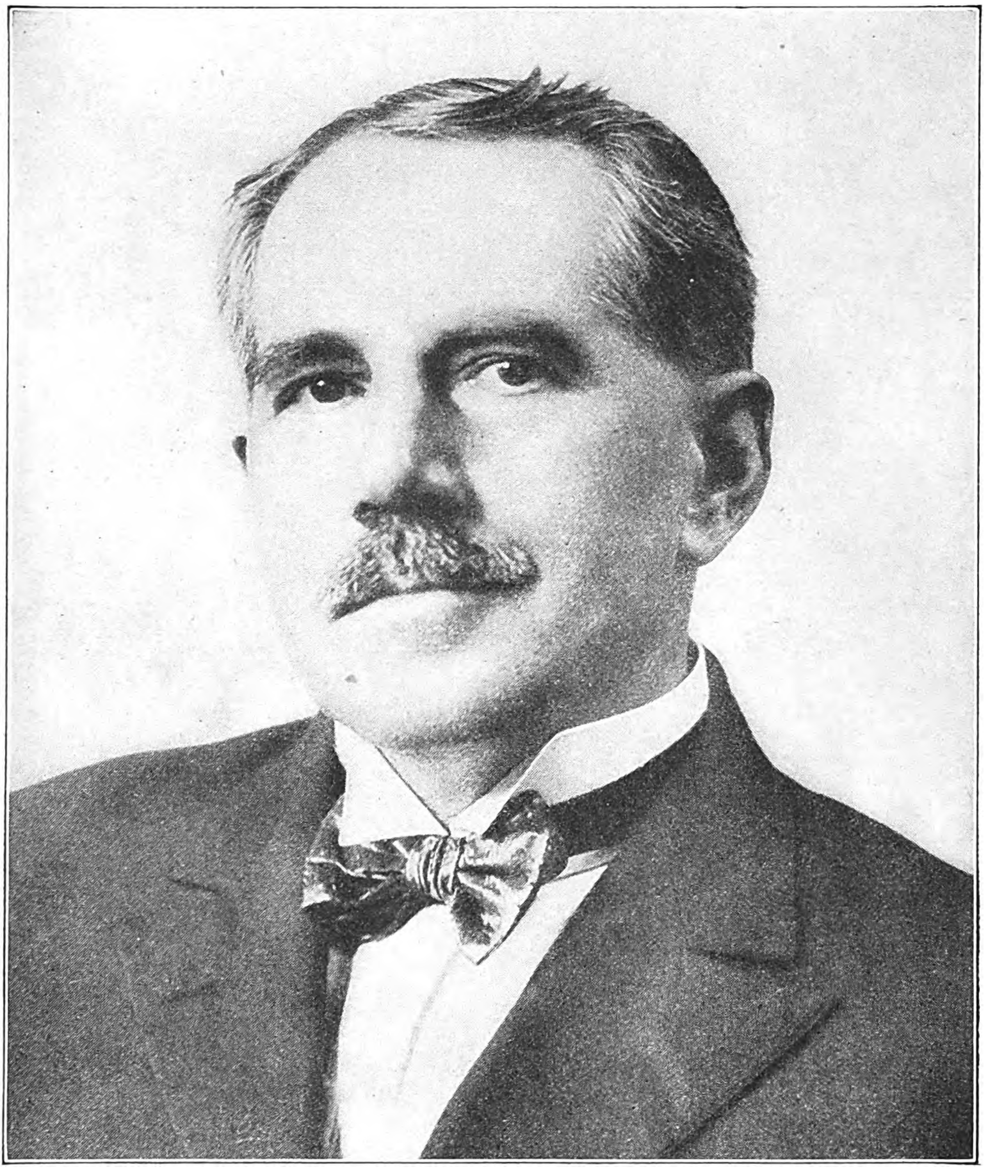
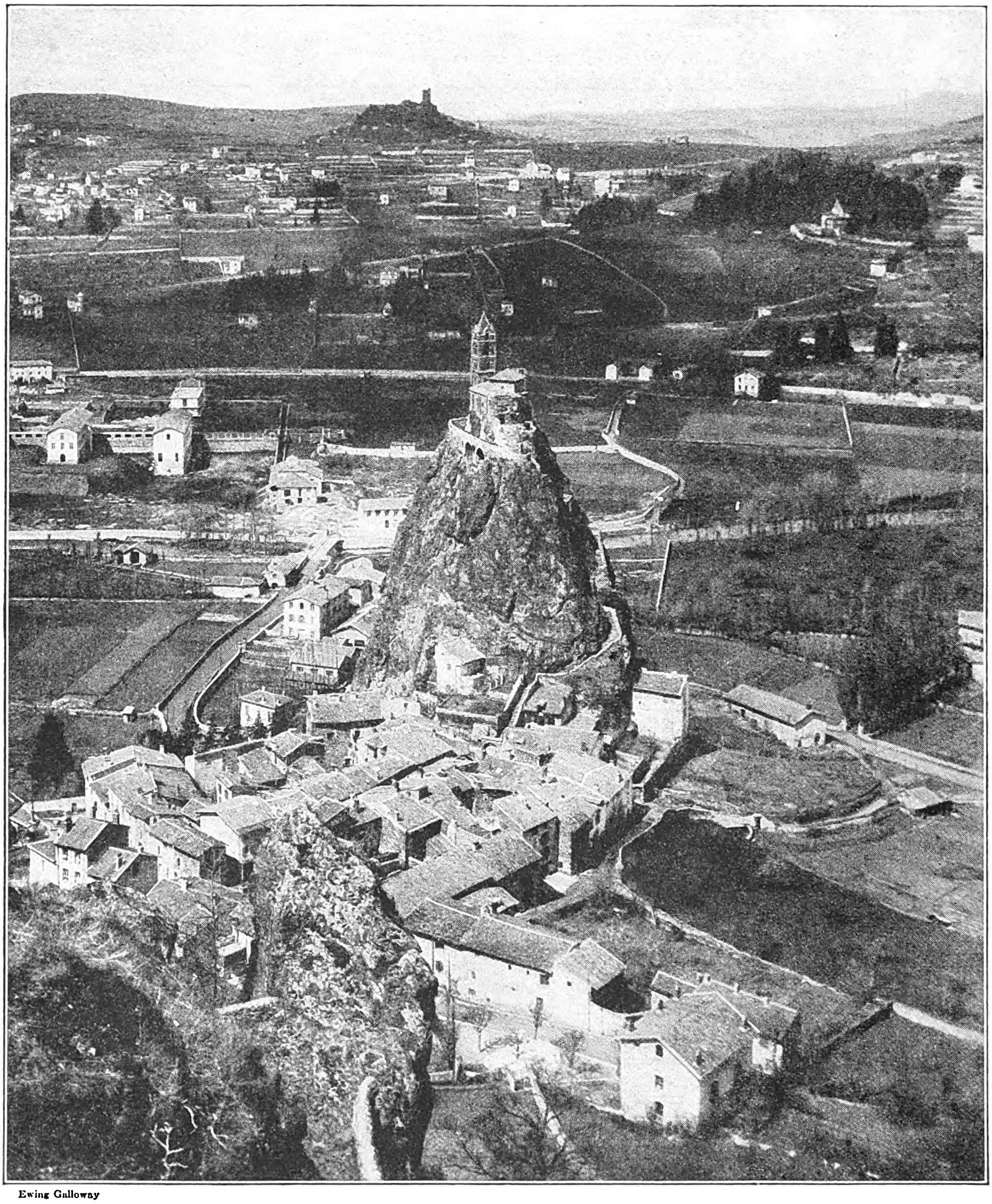


Charles F. Marvin

Professor Charles F. Marvin was educated as a mechanical engineer at Ohio State University. He has been Chief of the United States Weather Bureau since 1913, having been appointed upon the recommendation of the National Academy of Sciences, which was requested by President Wilson to submit names of men deemed eligible. At Colorado Springs, and Pike's Peak, early in his career, Professor Marvin conducted comparative observations of dewpoint temperatures and wet and dry bulb readings, which formed the basis of the tables for calculating the vapor content of the atmosphere. Later he was assigned to charge of the Instrument Division of the Weather Bureau, where he developed numerous forms of, and improvements in, meteorological instruments, including anemometers, barometers, raingages, pyrheliometers, seismic apparatus, and devices for securing observations in the upper air. He is the author of numerous papers and articles appearing chiefly in the *Monthly Weather Review*, dealing with meteorological questions; including analysis of the question of alleged variability of solar radiation on which attempts at long-range weather prediction have been made. He has also carried on important studies in the simplification of the calendar, and was the first to formulate the effects on leap year rules in the construction of calendars, arising from the known slow, very gradual changes now taking place in the length of the year.



Ewing Galloway

Ancient Architecture in Modern France

NEAR one of the gates of the quaint old French city of Le Puy, or Le Puy en Velay, in the department of Haute-Loire, 90 miles south-west of Lyons, stands this curious little Church of St. Michel d'Aiguilhe, perched on the very top of an isolated rock of basalt. The church may be reached only by the laborious ascent of 271 steps, some of which, zigzagging up the precipitous face of the rock, are visible in the picture. This oddly situated church was built not long before the year 1000, but its chancel, at the nearer end, is still older. To this church and to a larger one in the city of Le Puy itself, which is not included in the panorama, came during many medieval centuries thousands of pilgrims seeking paths of holiness. Beyond the church and tiny community, on the near horizon, is the old Castle of Polignac, now in partial ruins. The high, square 14th Century keep and a tower may be noted in the picture.

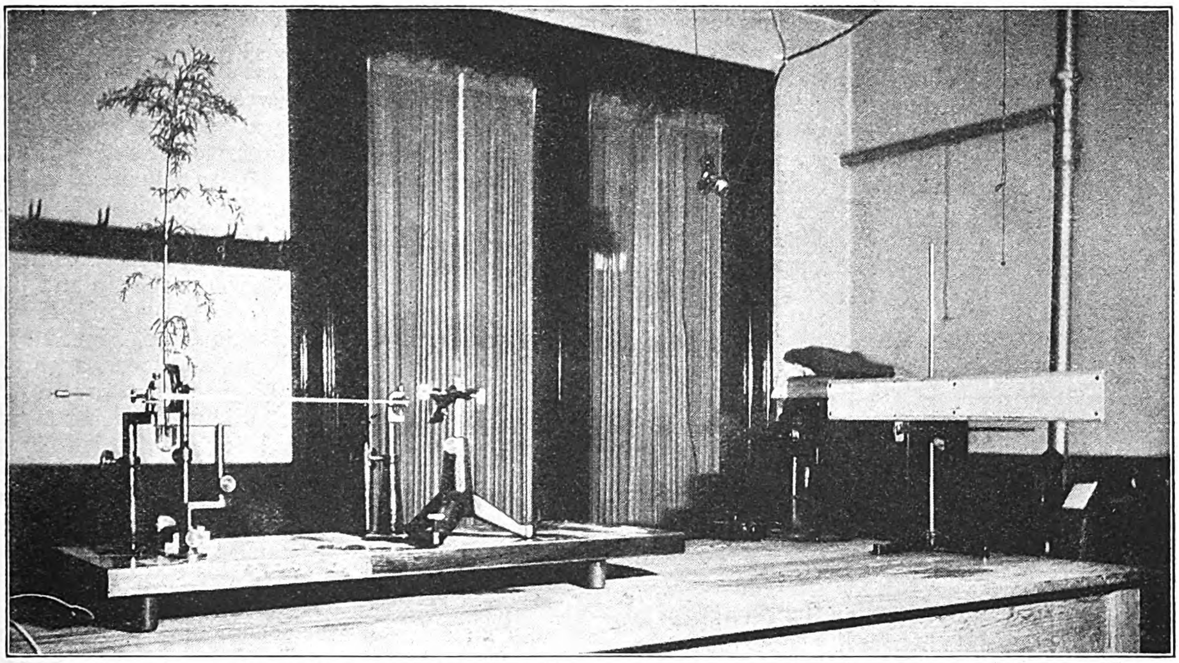


FIGURE 1: A PORTION OF THE LABORATORY, SHOWING THE SPHYGMOGRAPH

Have Plants a Heart Beat?

Using Great Refinement of Technique, an American Research Worker Repeats the Much Debated, Controversial Scientific Experiments of Sir Jagadis Bose, With Surprising Results

By G. A. PERSSON, M.D., M.S.

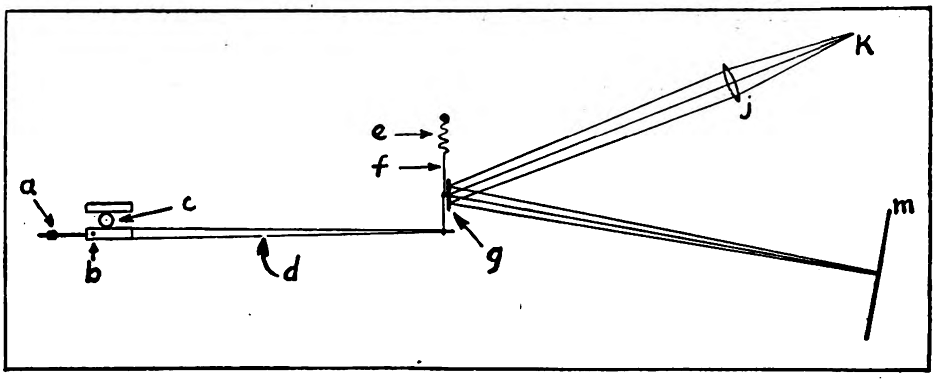
CONSIDERABLE controversy has already been occasioned in America by the publications of the well-known East Indian scientist, Sir Jagadis Bose; also by his many public lectures here. He not only claims to have proved by experiment that plants have "heart beats," but he sees evidences of life in metals and all other inorganic matter. These romantic claims, widely quoted in the American press, have reached an immense audience. We do not, however, know of a single American botanist of standing who accepts them. They have received some support in England, and a little in Europe. The experiments so lucidly described in this article lend no support to them.—*The Editor.*

SIR JAGADIS CHUNDER BOSE, famous Indian scientist educated at Cambridge University in England, founder of the Bose Institute at Calcutta, and author of a number of extremely interesting books describing his researches into the mysteries of plant life—researches which have brought him a knighthood and various honorary degrees—tells us in his latest volume, "Plant Autographs and their Revelations," that plants have a circulatory system essentially like our own, and backs this up by numerous diagrams showing the "heart beats" of various vegetables and flowers.

It must be confessed that this is a sufficiently remarkable discovery, but the present writer has, with all due respect, to report one even more astonishing. He has been able time and again in his laboratory to produce a perfectly good heart beat of fine rhythmical quality in a mere cotton lamp wick steeped in cabbage juice.

To find these pulsations in living tissue, even in an organism so low in the scale as a humble garden vegetable, is at least in line with what one might expect. But what shall be said of their appearance in inert and lifeless matter?

The answer to this question is a very simple one. I confess frankly that what in my experiments presented all the earmarks of a heart beat (to mix two metaphors) was nothing more or less than poor technique—when it did not happen to be caused, as it was in this particular instance, by simple molecular attraction. I could and can obtain nothing resembling a pulsation when I guard my apparatus rigidly

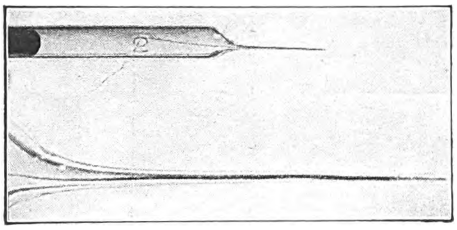


PLAN DIAGRAM OF THE SPHYGMOGRAPH

Figure 2: Lever *d* is pivoted at *b* and balanced by counterweight *a* and, under tension from spring *e* through thread *f*, bears against plant stem *c*. Light from source *k* passes through lens *j*, is reflected from mirror *g*, and is brought to a focus on scale *m*. Infinitesimal expansion or contraction of stem *c* is communicated through lever *d* to mirror *g*, which rotates slightly and causes movement of the light on the scale. Compare with Figure 1, at top of page

from all external influences that may affect it.

If you should ask me to give you with similar directness and brevity my views of the findings of the eminent Indian investigator, I should hazard the opinion that they represent what psychoanalysts call a "wish fulfilment." In plain language, I am forced to the conclusion that Sir Jagadis found heart beats in his plants because he wanted to find them there. They were what he was looking for.



THE ELECTRIC PROBE

Figure 3: Top—About normal size. Bottom — tip magnified three diameters

My attitude toward the distinguished Indian savant is one, on the whole, of respectful admiration. I acclaim his 30 years of inspired investigation into the dark places of plant life, upon which he has thrown much light. But I do feel that in the conclusions he has reached in his latest book he has allowed his emotions to run away with his reason.

What this well-known master of plant lore has proved by a great many able experiments is that plants respond to stimulation just as animals do. He has found that they react to changes in their environment in a manner closely akin to that in which we humans meet the varying vicissitudes of life; that their growth and vitality depend, like ours, upon the quality and quantity of the nourishment they obtain; that they can be poisoned and depressed, stimulated and revived by drugs and similar substances, exactly as we are—in a word, that they are in many ways creatures like ourselves, with more than a hint of the susceptibilities for which we are famous.

ALL these contributions to our knowledge of vegetable life, despite the occasional poetic fervor with which they were expressed, have been of great value and have gained a well deserved reputation for their author.

In "Plant Autographs and their Revelations," Sir Jagadis explains what one English editor, himself a well-known scientist, terms "his crowning achievement," the discovery that "sap in the plant is propelled by a mechanism which is essentially similar to that which maintains the circulation of the blood." He describes many of his own experiments which, in his opinion, make good this claim, and offers numerous illustrative diagrams showing the curves or electrically drawn records produced by the plants themselves by means of what he calls their "pulsations."

There is no denying the close apparent similarity between these diagrams of the pulse of plants and the cardiograms, or electrically made autographs of the human heart beat, (D, Figure 9) which the modern doctor turns out daily for his patients in the course of a complete physical examination. Is this similarity merely one of external appearance, or are the causes behind the records in the two cases also similar in kind? I will try to present as clear a résumé as possible of the experiments conducted in my laboratory at Mount Clemens, Michigan, with a view to answering this question.

The Indian scientist describes in his book different highly sensitive devices or apparatus to which he harnessed the plants he employed in his experiments. One of these was an electric probe, consisting of a tiny, pointed wire connected with suitable measuring instruments. He tells us that he pushed the point of this probe into the stems of plants a hair's breadth at a time, in order to find what he calls "the sensitive layer" in the tissues of his subjects. Through this probe he obtained electric currents or pulsations that indicated the heart beat, or its equivalent, in the flowers and vegetables upon which he experimented. He introduced infinitesimal doses of poison, such as strychnine, into the plants and found that these heightened the pulse beat. He increased the dose and found that it stopped the beat alto gether.

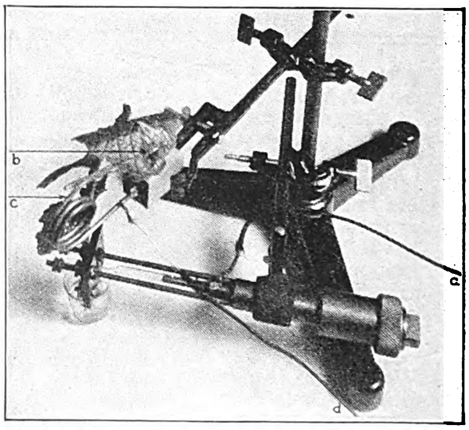
HAVING thus briefly outlined his recent researches into plant circulation, so to term it, I will explain how I came to investigate the matter. I am interested professionally in a group of diseases caused by what are known as toxins—poisons produced in the human system by harmful bacteria. In my laboratory my assistants and I do much experimental work with rabbits, rats, and guinea pigs, in order to study the action of these poisons and to try to find remedies for them. The work of Dr. Bose with plants came to my attention and I believed I saw in it a possible way for rapidly testing out these toxins as an aid to the treatment of the conditions caused by them in human beings. So my two assistants, Dr. Willard H. Bennett and Mr. Walter A. Greig, and I decided to attempt some of the experiments made at the Bose Institute, with a view to familiarizing ourselves with the technique of plant experimentation.

First of all we made an electric probe similar to that described by Sir Jagadis in his book. This probe consisted of a glass capillary tube drawn to a fine point, through which was led a platinum wire one two-hundred-and-fiftieth of an inch in diameter (Figure 3), in such a way that all but the tip was electrically insulated. The probe was mounted on a screw device having a very fine gage for measuring its tiniest movement accurately down to one 2500th of an inch. A photograph of the set-up of the probe is shown in Figure 4. Great care was taken to permit electrical contact nowhere else but between the probe tip and plant stem.

IN circuit (*a*, *d*, Figure 4) with the probe was placed a galvanometer, suitably protected from vibrations in the building by being mounted on a heavy brick pier, which in turn rested on eight rubber stoppers. The natural vibratory period or swing of the galvanometer, an exceedingly delicate instrument, was also determined, so as to be allowed for in all experiments.

Light from a heavy filament lamp was focused on an aperture $^1/_{32}$ of an inch in diameter, which was placed five feet, four inches from the mirror of the galvanometer. In front of this mirror was mounted a lens which focused the beam to an image five feet, four inches from the galvanometer. At this focal point a camera was set up which could move a two-and-a-quarter-inch film at any speed between four inches and 40 inches an hour.

With this apparatus in operation, if there were no pulsations in the plant, to be registered by the galvanometer as deflections, the film would show a perfectly straight line from end to end. If, on the other hand, there were pulsations or other changes in the plant, producing an electromotive force, the galvanometer would be deflected, and such deflection would be recorded as a V-shaped notch or break in the line on the film.



SET-UP OF PROBE AND LEAF

Figure 4: The electric circuit was completed through the heavy conductor *a*, the platinum wire in the probe, the probe tip, the epidermis of the leaf stem, the tissues of the stem and leaf, the epidermis of the leaf, the platinum wire *b*, the metallic leaf-holder *c*, and the heavy conductor *d*. When a leaf on a growing plant was used, the circuit was completed through a metal electrode in the soil, not through leaf

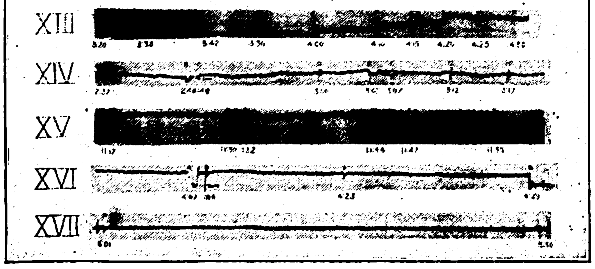
Sir Jagadis states in his book that he used the plant *brassica* in producing some of his curves. Since *brassica* is a genus of plants including the cabbage, cauliflower, turnip, and their near relatives, we picked the turnip as best for our purposes because it possesses a leaf with a stem. We also made measurements on *cosmos*, *antirrhinum*, *dahlia*, and other plants employed by Dr. Bose in his investigations. With all of these we obtained practically similar results.

WE set about our experiments with the idea of recording the pulsations described by Dr. Bose as occurring in the stems of plants due to the sap flow; also of measuring the changes produced in these pulsations by treatment of the stems with various drugs and preparations.

With every faith in the authenticity of the astounding results reported by the Indian scientist, we were naturally prepared to find these duplicated in our laboratory. In spite of the most scrupulous care in carrying out the technique somewhat scantily described in "Plant Autographs and their Revelations," we found ourselves utterly unable to produce the effects we looked for, or to discover anything in the nature of rhythmical pulsations in the living plant tissues.

Time and again we repeated the experiments, using apparatus of far greater delicacy than that described by Dr. Bose, but without obtaining the ghost of what we could regard as a genuine pulsation. We finally came to the conclusion that the facts, as we found them, should be given to the public.

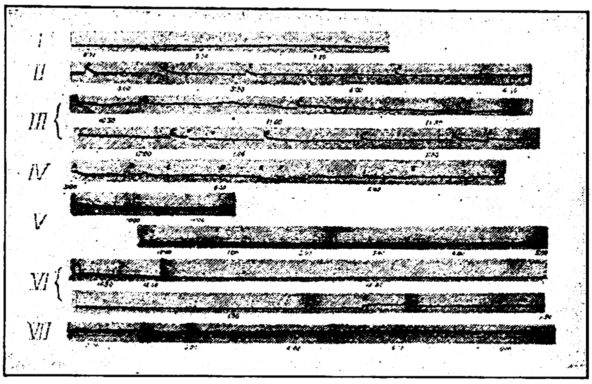
Our experiments were made both with leaves taken from live plants and leaves still attached to living plants growing in pots. They were carried on indoors and out of doors, by day and by night, and under greatly varying conditions of temperature and light. The films obtained in a few typical cases out of the very large number actually made are grouped on Figures 5, 6 and 7.



A THIRD SET OF CURVES

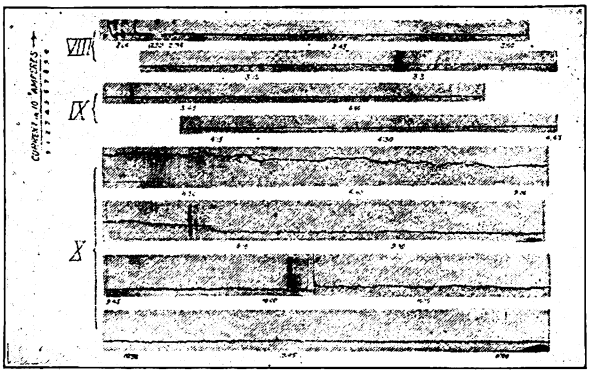
Figure 7: Compare these with curve C of Figure 9, which Sir Jagadis Bose regards as proof of a heart beat

During a number of these experiments our aim was, if possible, to locate the "sensitive layer," consisting of vascular nerve strands described by Bose in his book, as existing at a certain depth within the tissues of the plant stem. In order to try to reach this layer we would from time to time advance the probe more deeply into the stem by about one 250th of an inch. In this way we hoped to spot the layer by finding a decided increase in deflection of the galvanometer when we reached a certain depth, but were not able to do so. In other cases we were simply seeking for pulsations at any depth, or for other possible reactions on the part of the plant to different environmental changes.



SOME OF THE CURVES OBTAINED

Figure 5: These are explained in the text. The time durations are shown by numerals beneath the curves. Bracketed curves are continuous with one another



ANOTHER GROUP OF CURVES

Figure 6: The little flutters which show in curves X are attributed to the natural drift of the galvanometer

Our first two films, made by way of a check on the remainder, were not taken with growing or fresh cut leaves. One was made with the wires leading to the probe disconnected and free, and the other with the probe in contact with a dead and thoroughly sterilized stem. In both cases the films showed no deflection of the galvanometer—that is, no pulse—whatsoever, but merely a very faint vibration probably due to disturbances in the air of the laboratory. Curve 1 in Figure 5 shows this type of record, practically a straight line. The figures beneath it, as under all the curves, indicate the hour of the day, the film in this case having been run from about 8:25 to 9:45.

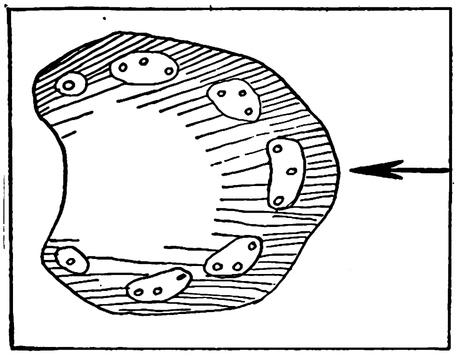
Brackets at the left of curves show that the films concerned were run as continuations of each other. The letters A,B,C,D, and so on, above each curve indicate points at which something was done by one of the experimenters. Either the point of the probe was pushed forward a tiny fraction of an inch, about one 250th as a rule, in search of a more sensitive layer of tissue—making the jerky breaks seen on curves II and III of Figure 5; or the galvanometer deflection was tested, as at the sudden dips on curve XI of Figure 7; or the plant was watered; or a weak strychnine solution was administered to it; or the light was suddenly increased or decreased; or the camera was darkened; and so on. All the marked or heavy deflections or zigzags in every one of the curves shown were caused, not by spontaneous activity on the part of the plant, but by some action of ours, some change introduced into the conditions by one of us. For example, every time the probe point was advanced a fraction of an inch it penetrated new tissue having a different electric potential, thus causing a slight flow of current in the circuit and a corresponding dip in the curve recorded on the film.

Some of the curves are more tremulous or wavy than others—for example, curves IV and VII on Figure 5 and curve X on Figure 6. These records were taken out of doors and we believe that disturbances in the air and vibrations of the soil may possibly have had something to do with this.

IT is possible also that the wilting of the leaf, which occurred during curve IV of Figure 5, caused small contractions of the stem, which would move the tissues of the plant little by little in relation to the probe tip, causing a series of minute deflections in the galvanometer owing to the change of electrical potential thus encountered.

Be this as it may, we found that, as we went along, our curves, which at first had been decidedly wavy, became more and more like straight lines, except for the breaks or dips caused by something we did to the plant or the apparatus. We began to suspect after a while that this was due to an improvement in our technique, and made a number of experiments to learn if this were the case. We finally satisfied ourselves that it was.

Our reasons for arriving at this conclusion were, in part, that we found that while the films were being run, walking about the room, a very large one having a concrete floor; or merely standing still in the neighborhood of the apparatus and moving one's hands, arms, or body; or turning the electric lights on or off; or even blowing softly on the galvanometer wires—all had a more or less marked effect on the curve, sometimes quickly passing, sometimes lasting for an appreciable period. These effects were partly of a mechanical and partly of an electrical nature, being due in some cases either to vibrations in the floor of the room or to air currents produced by our movements, and in others to the electric charges in our bodies which gave rise to induced currents in the galvanometer circuit when we approached it.



CROSS SECTION OF PLANT STEM

Figure 8: Showing sensitive areas and vascular strands. Arrow indicates probe

BY taking the greatest care not to go near the apparatus unnecessarily; by moving, when we had to move, as softly and as far away from the instruments as possible; by improving the insulation of the conductors; and by taking other precautions indicated by our tests as likely to prove helpful, we were able practically to eliminate the waviness, or what Dr. Bose would call the "pulsations," from our later films. Curves made by starting the apparatus and then leaving the room for an hour or more at a time, locking the door to keep out intruders, resulted in straight lines with no sign of any pulsation, and only an occasional very slight waviness which could readily be explained by galvanometer drift, something that can not be avoided when using an instrument of such great sensitiveness. Curve XVII in Figure 7 is a typical example of such a film.

The test made with the circular lamp wick, to which reference has already been made, was carried out as a check, and in order to see what would take place in the case of a loosely woven column of non-living material saturated with a liquid of approximately the same density and chemical character as the sap of the plant. We allowed the wick to stand in a beaker containing juice squeezed from a fresh cabbage leaf, and connected it in circuit with the electric probe exactly as we did the plant stem. The curve resulting from this, which would seemingly indicate a vigorous heart beat, is shown at E, Figure 9. The heavy dip in this curve was caused by our testing the galvanometer deflection for a moment, and the wavelike character of the rest of the record was probably due to irregularity in the capillary flow at the point immediately adjacent to the probe tip.

In certain of the curves we obtained, as for example in Curve X of Figure 6, there are to be found here and there short successions of waves of a period of about ten seconds, the natural period of the galvanometer we used, interspersed with a larger number of random deflections which it would seem to us absurd to liken to a heart beat. We believe these waves to have been caused by external influences.

Now, had we selected certain parts of this curve, we could have presented something very like the curves published by Sir Jagadis, but it seems to us that the only truthful way in which to report an experiment of this sort is to give every curve in its entirety, as we do in all cases. To pick spots that fit in with one's theories is, to say the least, somewhat misleading.

CURVE A of Figure 9 is an example of the deflection traceable to manipulation. The dotted line indicates a condition of drought; the continuous line a period of watering. Opposite this, at B, are the results, due to poor technique, obtained in some of our preliminary experiments. These, if accepted at their face value, would have provided good evidence for a heart beat. For purposes of comparison, curve C is borrowed from Sir Jagadis Bose's book. It shows records of electric pulsations under alternate drought (dotted line) and irrigation (continuous line). Curve D, also included for purposes of comparison, is a cardiogram showing the beat of the human heart. Upon studying curves A and C together, it will be noted that in both cases considerable activity is exhibited during the watering period. So far as curve A is concerned, we are convinced that this was due to handling, and not to vital processes within the plant.

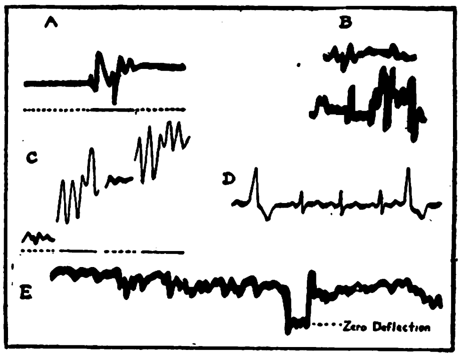
Besides constructing the electric probe we also went to great trouble to build a sphygmograph according to the scanty specifications given by Sir Jagadis. This is an instrument normally used for recording the character and strength of the pulse beat. We made this sphygmograph as sensitive as modern mechanical knowledge permits. A picture of its set up is shown in Figure 1, to which Figure 2 corresponds. The highest sensitivity was found when the amplifications were 260,000 times. Careful observation with this instrument showed no pulsation whatever in the diameter of the stem of the plants used, which were *cosmos*, *antirrhinum*, and *dahlia*, Dr. Bose's own specimens. We should be greatly interested to see the complete specifications of the sphygmograph with which he obtained the amplifications of 10,000,000 times, as he states.

IN conclusion, I wish to draw attention to Dr. Bose's deep conviction of the essential unity of all life, a conviction which he himself voices in no uncertain terms and which is implicit in much of the philosophy of India, his native land. This attitude of mind may have unwittingly colored the conclusions he draws from his experiments.

To quote his own words, as printed on the final page of the appendix to his book:

"India through her habit of mind is peculiarly fitted to realize the idea of unity and to see in the phenomenal world an orderly universe. It was this trend of thought that led me unconsciously to the frontiers of different sciences and shaped the course of my work in its constant alternation between the theoretical and the practical."

It will be left to those who have read thus far to decide for themselves whether or not this trend may have been the father to the finding; and if the philosophic theories of the Indian writer may not have influenced his scientific judgments.



FIVE INTERESTING EXHIBITS

Figure 9: A, Effect of irrigation. B, Poor technique. C, From Sir Jagadis Bose, "Plant Autographs and their Meaning," reproduced by courtesy of the Macmillan Company. D, Cardiogram, reproduced from Bishop, "Heart Troubles," by courtesy of Funk and Wagnalls. E, curve produced by lamp wick in cabbage juice

¶ *During the last glacial epoch a part of the area of Alaska escaped the covering of ice which removed various evidences of fossil, and possibly human, life. In a subsequent issue an Alaskan geologist will set forth plans for investigating this promising area.*

OUR POINT OF VIEW

A Greater Merchant Marine

THE news that the government has sold the United States Lines and is, therefore, out of the shipping business, has been welcomed by many throughout the country. The nation has in late years become "merchant marine minded," and there has been much discussion of the problem of building a system of shipping lines that would be second to none in the world. Governmental operation of such lines has been criticized a great deal but the principal criticism seems to have centered around the fact that, due to the question of the status of the United States Lines—that is, what final disposition would be made of them—there has been little chance for expansion and development.

Mr. Paul W. Chapman, to whom the lines were sold, already controls about 90 electric, gas, railroad, water, and other companies and has been so successful in the operation of these that it is predicted that he will be eminently successful in his new venture. A good indication of the high repute in which Mr. Chapman is held and an augury of the probable progressiveness of the lines under his management, may be seen in the fact that banking interests, hitherto indifferent to shipping, have evinced a desire to participate financially in their operation.

Our renascent merchant marine will now, no doubt, claim a greater measure of public attention than it has since the war. That intangible thing called prestige will account for much of that attention; the necessity for a larger merchant marine which might be used as a naval auxiliary in time of war will account for more; and the fact that our constantly increasing production and export trade requires American bottoms in great numbers, will share perhaps the greatest. Another important feature to be considered is that private operation of these lines will probably stimulate American shipbuilding. The new owners are bound by the terms of the sale to build two running mates to the *Leviathan* and are already considering construction of five smaller ocean liners.

The Summer Fight

EARLY in March the city of New York appropriated 100,000 dollars with which to wage an intensive anti-mosquito fight. Breeding grounds are to be drained or covered with oil, and the assistance of the public is to be enlisted through the medium of literature distributed to Boy Scouts.

Many other communities will make similar fights during the coming summer—for a very good reason that may be stated statistically. One lone female mosquito can produce 159 billion offspring in one year, according to Dr. Thomas J. Headlee, chief entomologist of the New Jersey Agricultural Experiment Station. About half of these are males which do not bite, Dr. Headlee says, but the other half!—biting, pestiferous, disease-carrying females.

Aviators Do Die Naturally

THE opinions of the great majority of people are as changeable as the tides; they ebb and flow and are never quite the same from one day to the next. At present they are wavering back and forth on the question of the relative safety of aviation. No sooner has the tide of public opinion swung to the side of confidence in aviation than it promptly swings back to the side of distrust because two or three unavoidable accidents have occurred.

Airplane mileage figures are repeatedly cited to show that the percentage of accidents is very low and yet the distrust continues. Strangely, almost a wave of horror will sweep the country when news of an airplane crash is published, although scarcely any attention is given to the large daily toll of lives in automobile and railroad accidents.

From France come some interesting figures which should rather definitely prove that aviation is safe. Out of the first 101 pilots to receive certificates from the International Federation of Aeronautics, it is said that 67 are alive today. Only 12 of the others have died in actual service in the air, and the remaining ones all died natural deaths. Perhaps this is proof enough for the time being but most of those who read it will change their minds when they read in tomorrow's paper of the death of one student flier; the few hundred automobile fatalities won't count.

New York City and other communities which started the fight early are to be complimented on their foresight. Other communities and even individuals who have been remiss should not hesitate to enter the fight at once. Rain water in tin cans, barrels, roof drains, or yard depressions are favorite breeding grounds for these pests and are often found to be full of the wrigglers. Such containers should be emptied, drained, or the water therein should be covered with almost any kind of oil that will exclude air from the surface. Tin cans, when thrown on a dump, should always be punctured in several places so they will not hold water.

Prevalence of mosquitoes not only constitutes a health hazard, but also may have a direct effect on real estate values, especially in the case of summer resorts. Therefore even selfish people have a strong incentive to aid in the fight. But, regardless of the motive, may the fight go on relentlessly until these vampirish insects are under control and the percentage of bitten ankles is materially lowered.

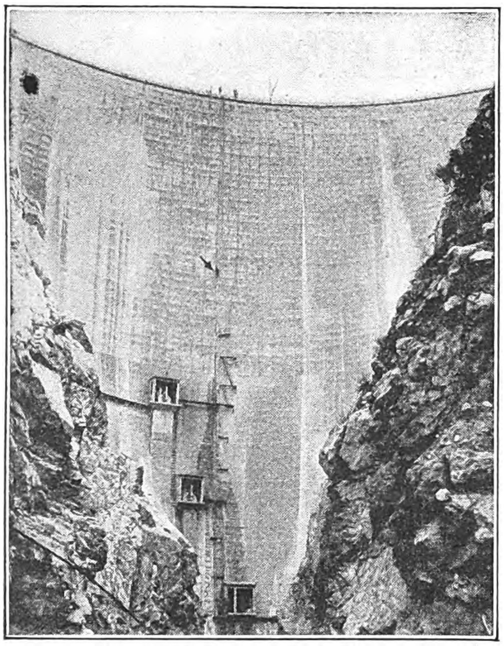
Thug Gas Warfare

RECENTLY a judge made a statement to the effect that he would be inclined to be much more lenient with a hold-up man who used tear-gas in committing a robbery than he would with one who used a pistol. He gave as his reason the well-known fact that the victim of a hold-up who is shot often dies or is maimed for life, whereas tear-gas would simply incapacitate him for a few minutes and would have no after effects.

There is nothing unethical in the judge's attitude, for to all who have any knowledge of non-toxic gases, the popular prejudice against the use of them by the police is incomprehensible. At this writing, the Police Department of the city of New York is contemplating the adoption of gas and the passing of an ordinance that would make possession of any sort of gas gun by a civilian a felony comparable to that for possessing a pistol. Police armed with a few bombs containing this gas or special pistols for shooting it could effectively disable criminals temporarily so that they might be captured without bloodshed.

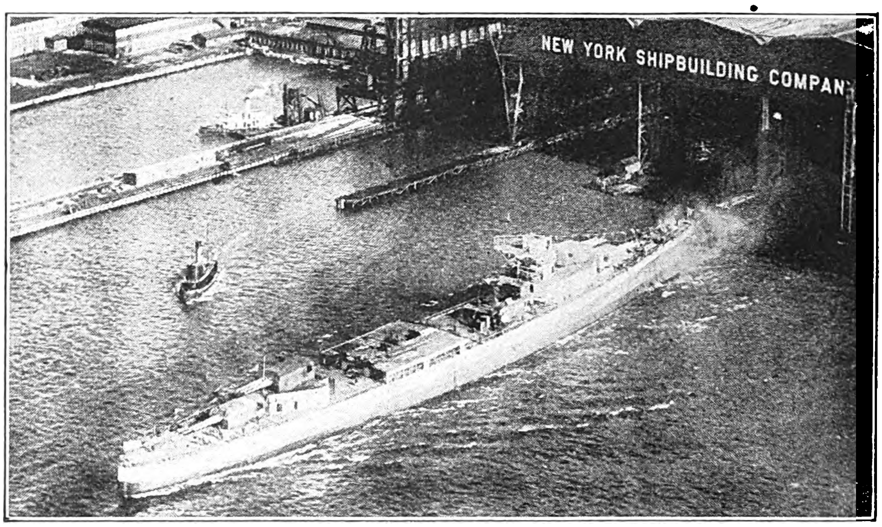
So far, so good; but criminals should be encouraged to use gas instead of pistols. The arming of police with gas would tend to have the effect of causing the thug to abandon his pistol since his own life would not be in such great danger; consequently the lives of many citizens and policemen might be saved. If possession of a gas-throwing device should be as felonious as owning a pistol, he might hesitate to make the change. Certainly he should be punished for carrying gas, but the law governing this should not have too sharp teeth. It is better that fewer murders be committed than that we *attempt* by bloodshed to save the few paltry dollars thugs might more easily obtain by using gas.

From the Scrap-book of Science



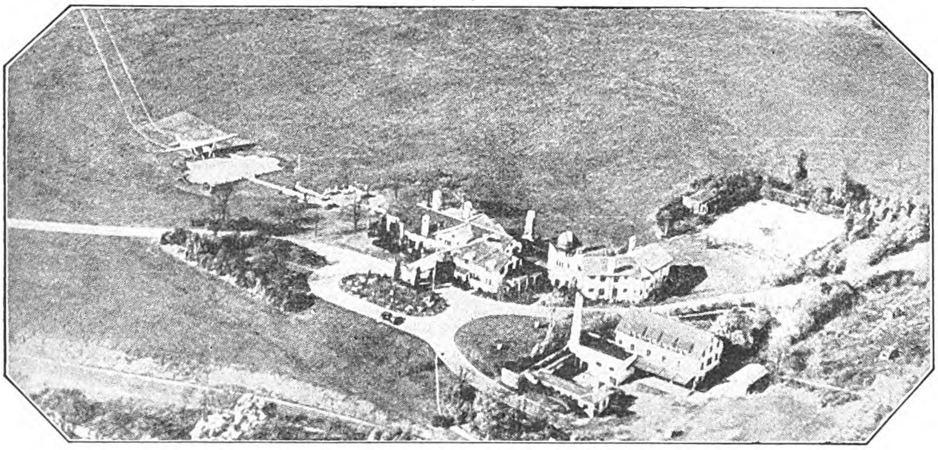
WORLD'S HIGHEST

The arrow points to a man working on lower face of Pacoima Dam, 376 feet high, near San Fernando, California. Built by Los Angeles County, it took four years to build, cost 2,500,000 dollars, is 660 feet long at top, with a base 100 feet thick



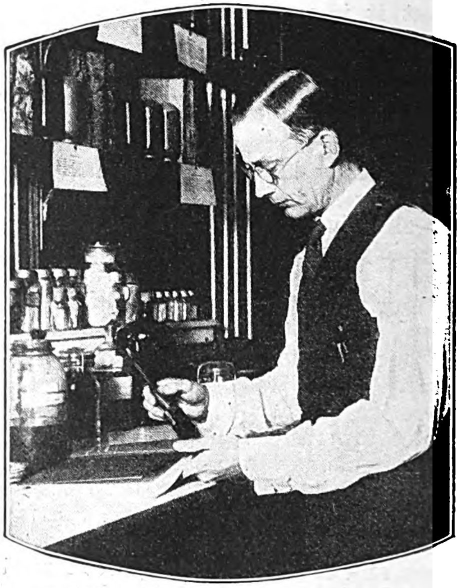
THE LATEST ADDITION TO OUR FLEET

The *Salt Lake City*, first of eight 10,000-ton cruisers now being built by us under the terms of the Washington Conference, takes to the water at the Camden, New Jersey, yards of the New York Shipbuilding Company. She will have 10 eight-inch guns, four five-inch guns, and six torpedo tubes. She was laid down in 1927



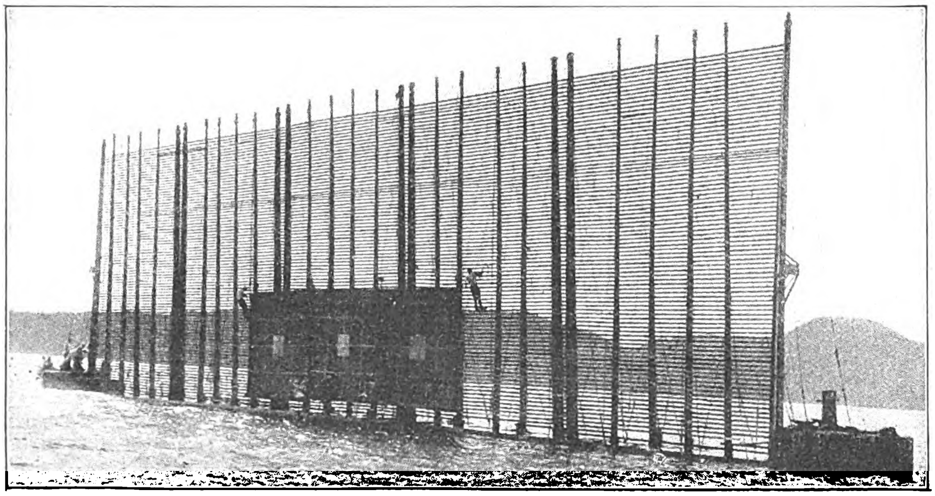
THE FAMILY PLANE MAKES ITS BOW

Predictions have been made by many people that the time is near at hand when planes in great numbers will be used privately, and indications point to the fulfilment of that prediction. This illustration shows the private airplane owned and used daily by Colonel E. A. Deeds, New York banker, at anchorage on the grounds of his country estate at Dayton, Ohio. The plane may be seen in upper left corner



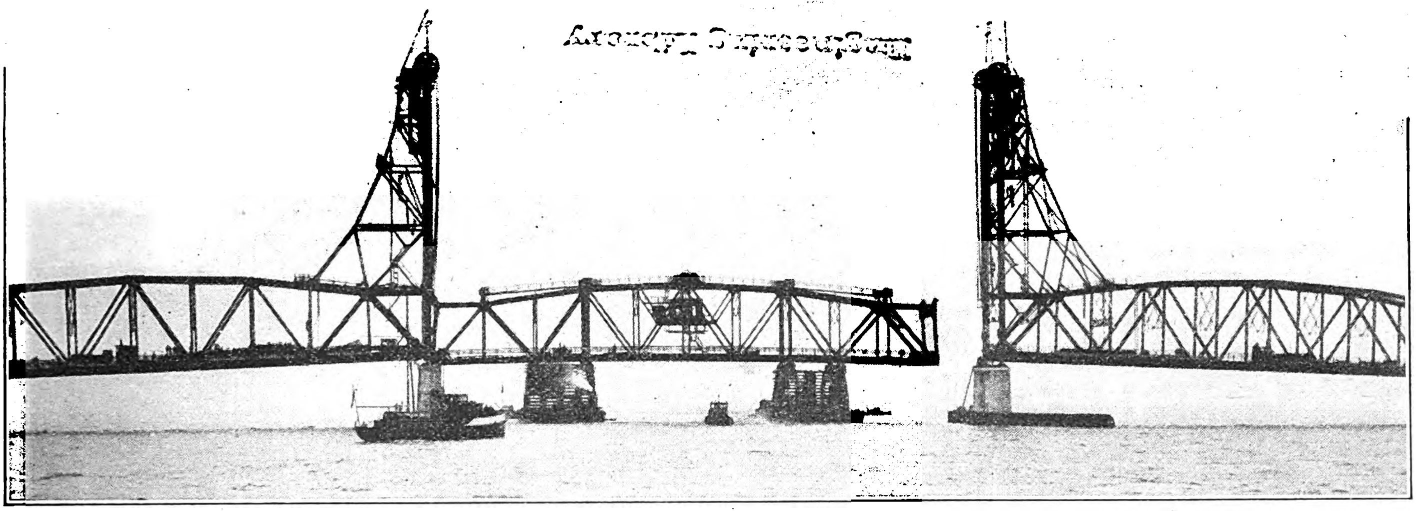
ROACHES EAT BOOK COVERS

Materials generally used for filling and finishing book covers are relished by roaches. These insects do not attack unfilled cloth bindings or those of a water-insoluble nature or finish. Books can be roach-proofed by the method used by Mr. R. W. Frey, of the Bureau of Chemistry and Soils, who paints book covers with a lacquer



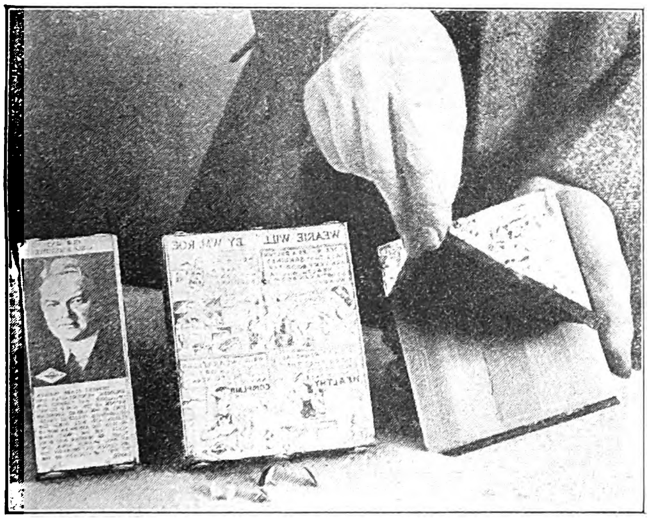
◄ HOW SKILLFUL ARE THEY?

A close-up view of a target used by the navy for testing the skill of gunners. This particular target is being adjusted by sailors of the *U. S. S. Pittsburgh* in Merivales Bay near Manila in the Philippines, preparatory to night firing. The target consists of a lattice-work on a partially submerged raft, with a canvas bull's-eye. It is towed far behind a fast vessel



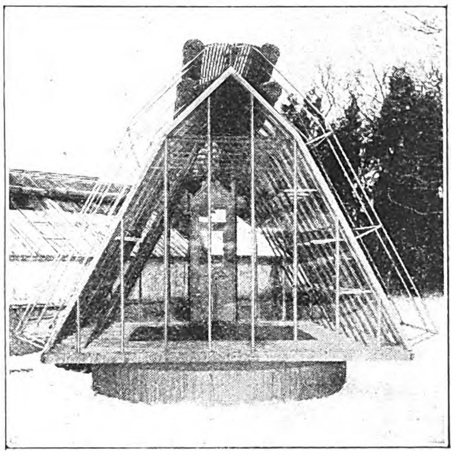
INSTALLING A BRIDGE SPAN WITH "MOON POWER"

Engineers on the 7,500,000-dollar highway bridge across San Francisco Bay (longest in the world—see SCIENTIFIC AMERICAN February, 1929) laid careful plans to use the tides—i.e. moon power—to install the huge lift span. Accordingly, the 303-foot span, weighing 613 tons, was installed on barges at a height previously calculated accurately, was floated into place during high tide, and was slowly installed in its permanent position as the receding tide lowered it. The operation was successful



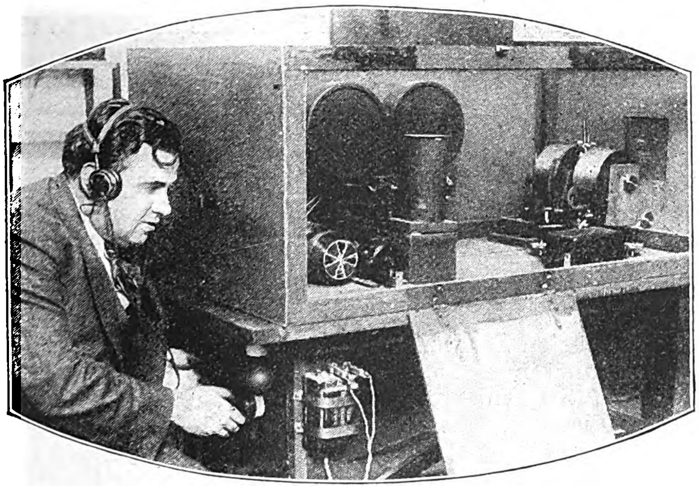
PAPER PRINTING PLATES

The printing industry, which has long depended on heavy metal cuts, is stirred up over the announcement of a newly-invented printing plate which is so light that it can be sent through the mail as first class matter and yet is strong enough to stand more wear and tear than metal. Fred C. Goldenbaum is the inventor. The plate is produced under a pressure of 4500 pounds. It is being used by many daily newspapers and weeklies in the United States



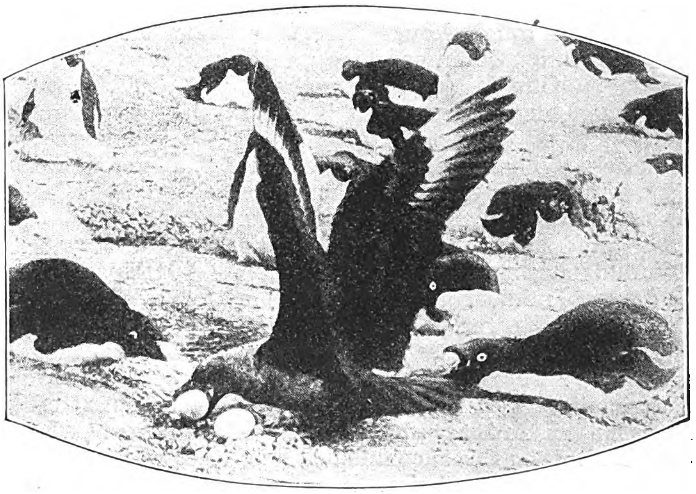
FOLLOWING THE SUN

A patent has just been issued to Mr. Albert C. Burrage, president of the Massachusetts Horticultural Society, for a rotating greenhouse such as the one shown here which he has erected at Orchidvale, Massachusetts. Although only 12 feet square, it provides space for 10,000 seedlings on its shelves. As it rotates with the sun, the seedlings always receive sunlight



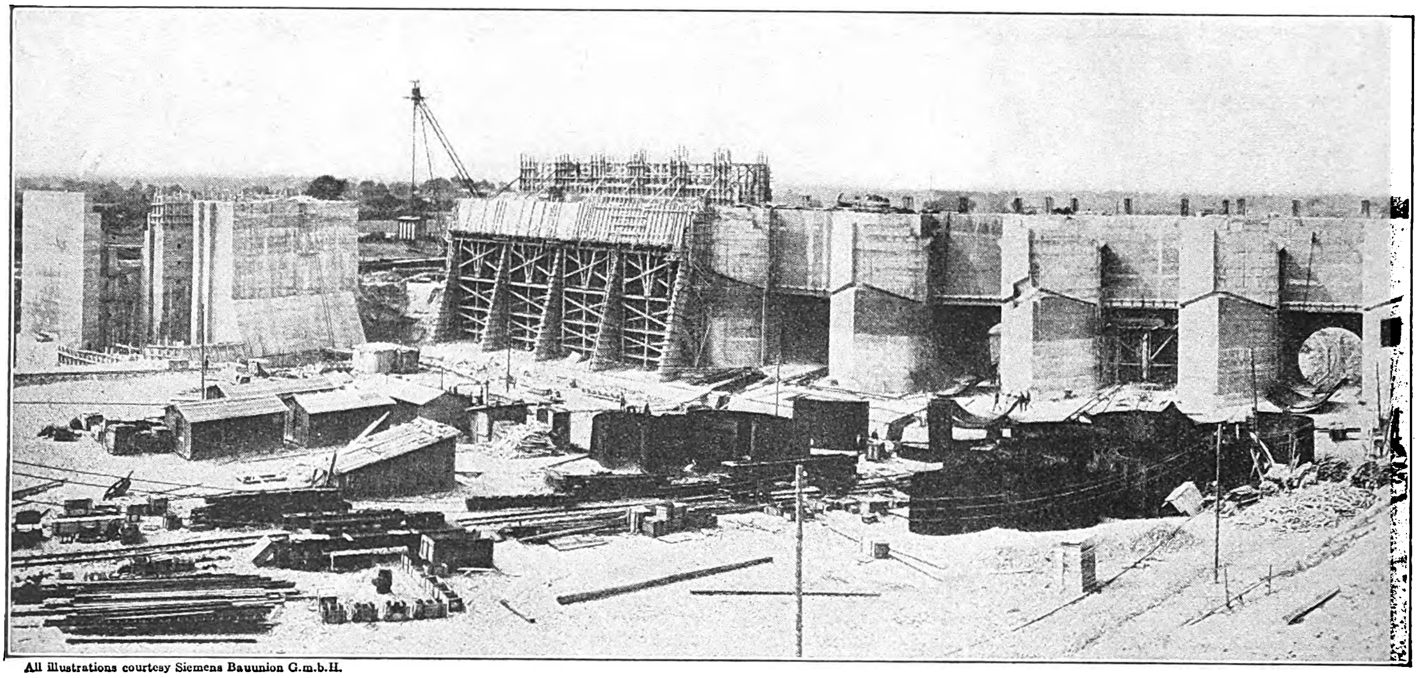
THE HEART ON THE "MOVIE" SCREEN

Although the X ray depicts the phases of the heart in action, it shows only the heart. The stethoscope gives only the sound of the heart action. By means of a new machine, the osciographoscope, invented by Lieutenant E. H. Hansen, of Los Angeles, slight changes of heart pulsation may be photographed by a "movie" camera, recorded on a phonograph record, and shown on a motion-picture screen



DAYLIGHT ROBBERY IN THE ANTARCTIC!

This photograph, taken within 200 miles of the South Pole, shows some of Commander Byrd's wild neighbors, permanent residents of barren antarctic lands. A penguin's nest is raided by a hungry seagull while the adults attempt, rather futilely it seems, to do something about it. This photograph is remarkable in that the seagull seems utterly oblivious of the camera man. Penguins are always tame



All illustrations courtesy Siemens Bauunion G.m.b.H.

THE LOWER END OF THE HEAD RACE

Intake sluice building from the head race side showing openings for the penstocks, the one at the right being open. One of the cable crane towers can be seen in the distance. The size of the work in this forebay may be compared with men near the penstock openings

Where the River Shannon Flows

A Huge Hydro-electric Plant, Being Built on This Great River, Will Add Greatly to Ireland's Power Supply

By F. D. McHUGH

UP near Sligo on the west coast of the Irish Free State, a river rises in County Cavan and starts somewhat proudly on its way to the sea. Very soon it broadens out into a lake, beautiful Lough Allen, passes on southward through Leitrim, between Counties Roscommon and Longford, through Lough Ree, past Athlone and Counties Westmeath, Galway, Offaly, and Tipperary, through Lough Derg and County Clare, and on down to the sea below Limerick. The stream which thus almost cuts off nearly a fourth of Ireland is the River Shannon, famous in song and story, and a symbol of the Emerald Isle; it is a river dear to the hearts of millions of Irish people throughout the world.

The waters of this world-famed river are being harnessed. A great hydro-electric project is in process of construction at Ardnacrusha near Limerick and, when this is completed, long high-tension transmission lines will carry its electrical power to practically all of Ireland.

The economic significance of this scheme can be realized when it is understood that the area to be supplied with power from this one source is over 25,000 square miles, that the plant is 120 miles from Dublin which is the largest established center of consumption, and that high-tension lines up to 225 miles long will be needed. Furthermore, this plant will practically triple the present electrical supply of the Irish Free State. While this is far more than the present economic situation of essentially non-industrial Ireland demands, the entire project was predicated upon the prospect of rapid expansion of industry, of the establishment and importation of new industries, and the possible use of River Shannon power on farms, for the cheap manufacture of chemicals, et cetera.

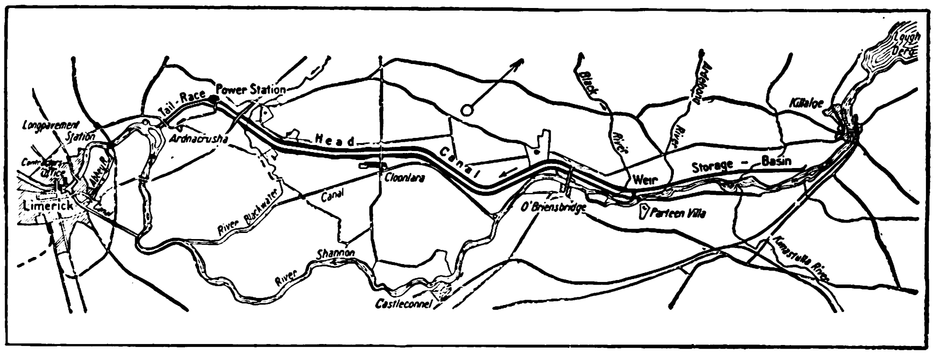
THE work now in progress was decided upon by the Irish Free State early in 1925 following the favorable report, rendered by a commission of experts, upon the proposal that had been submitted by a firm of German engineers. The Shannon Electricity Act which was passed in June of that year authorized the beginning of construction of the first stage of the project. The total installation will give the plant a capacity of 180,000 kilowatts in six generators of 30,000 kilowatts each, while the so-called "partial development," now under construction, will consist of only three generators with a capacity of 90,000 kilowatts. The partial development will include:

1. Excavation and erection of embankments along the Shannon between Portumna and Banagher.
2. Damming of the river between Lough Derg and the main weir.
3. Erection of the weir at Parteen Villa and of the intake building to the head race.
4. Construction of the head race from the weir to the power station at Ardnacrusha, a distance of nearly eight miles, with the embankments, syphons, culverts, and bridges.
5. Construction of power station and the two navigation locks at Ardnacrusha.
6. Construction of the tail race.

The cost of the first stage of the work will be in the neighborhood of 15,000,000 dollars exclusive of the network of transmission lines and the switch house. Of this amount about 2,500,000 dollars will be expended for the electrical and mechanical parts. The work on the partial development was started in 1925 and it is expected that it will be completed this year.

The watershed of the River Shannon, an area of 4000 square miles, is about one sixth the area of, and the largest drainage area in, Ireland. It has comparatively little fall in its upper and middle reaches but between Lough Derg and the tidal estuary near Limerick the fall is fairly high. Consequently the upper portion with its three large lakes—Allen, Ree, and Derg—with a total area of 99.5 square miles, is suitable for impounding water. The fall of 92 feet between Lough Derg is to be utilized for power generation in the new plant. Also the waters of only Lough Derg are to be used in the partial development. In this lake the level will be regulated to provide a useful storage of 6,568,000,000 cubic feet of water. Earth embankments will be constructed at low points on the shores of this lake to prevent flooding of the land which, in turn, will be drained by pumps.

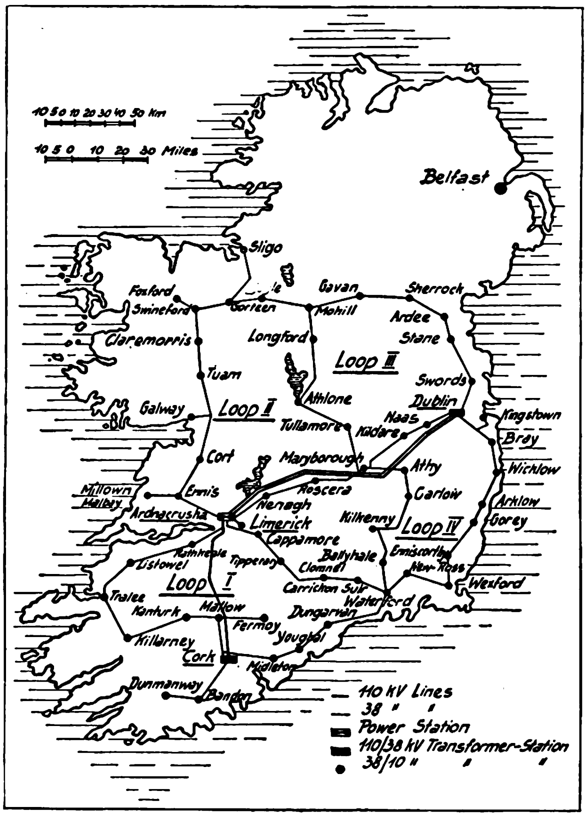
Lough Allen and Lough Ree will be utilized in the further development, or second stage, to store 20,234,922,000 cubic feet of water. In the last stage—the final development—the level of Lough Derg will be raised so that the total storage of the three lakes will be 29,204,000,000 cubic feet.


Power Station
Tail-Race
Longpavement Station
Contractors Office
Limerick
Abbey R.
Canal
Ardnacrusha
Head Canal
Cloonlara
Canal
River Blackwater
River Shannon
Castleconnel
O'Briensbridge
Parteen Villa
Weir
Storage - Basin
Black River
Ardclooney River
Killaloe
Lough Derg
Kilmastulla River

THE RIVER SHANNON SCHEME

Map of the district in which the hydro-electric project is being constructed, showing the main weir near Parteen Villa, the head race, the power plant, and the city of Limerick

ALTHOUGH the project is primarily a power generating scheme, it also takes into consideration the question of navigation. When the partial development is complete, barges of 150 tons capacity can go up the tail race, through locks at the power plant, and out into the river again through the ship's pass at the intake building. Previously, barges of only 40 to 60 tons capacity could negotiate the locks between Limerick and Lough Derg, although locks at important points above this lake already accommodate 150-ton barges.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Foxford
Swineford
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Cavan
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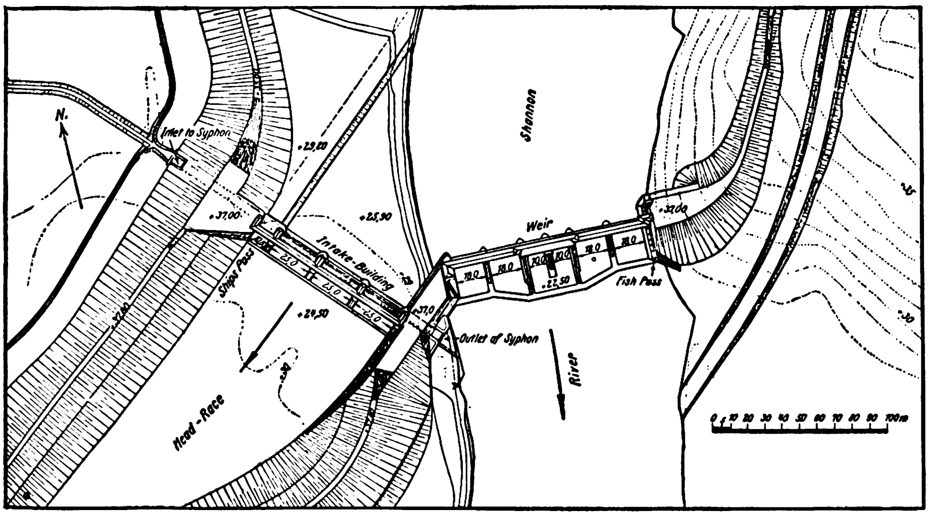
Sherrock
Ardee
Slane
Claremorris
Longford
Loop III
Tuam
Swords
Dublin
Galway
Loop II
Athlone
Tullamore
Naas
Kildare
Kingstown
Bray
Cort
Maryborough
Athy
Wicklow
Millown Malbay
Ennis
Roscera
Carlow
Arklow
Ardnacrusha
Nenagh
Limerick
Kilkenny
Loop IV
Gorey
Cappamore
Rathkeale
Tipperary
Ballyhale
Enniscorthy
Listowel
Clonmel
New Ross
Loop I
Carrick on Suir
Wexford
Tralee
Kanturk
Mallow
Waterford
Dungarvan
Fermoy
Killarney
Youghal
Cork
Midleton
Dunmanway
Bandon
110 kV Lines
38 " "
Power Station
110/38 kV Transformer-Station
38/10 " " "

THE TRANSMISSION NETWORK

Comprehensive plan of the high-tension lines over the Irish Free State, with the exception of 10,000-volt lines

The scheme will also have an effect on agriculture since floods are to be controlled and certain land is to be kept drained. The completion of the partial development alone will make arable 12,000 acres. A fish pass was constructed at the main weir to allow salmon to reach their spawning grounds.

At the principal weir, which is in effect a dam, the water level will be 25 feet above the present average level, thus necessitating construction of earth embankments extending some distance upstream. The Ardclooney River will discharge into the Shannon above the weir and the Blackwater and Kilmastulla Rivers will be diverted along the head race and eventually discharge into the Shannon below the weir.


N.
Inlet to Syphon
.23,80
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18,0
.22,50
.37,00
Fish Pass
Outlet of Syphon
River
Head-Race
0 5 10 20 30 40 50 60 70 80 90 100m
35
30

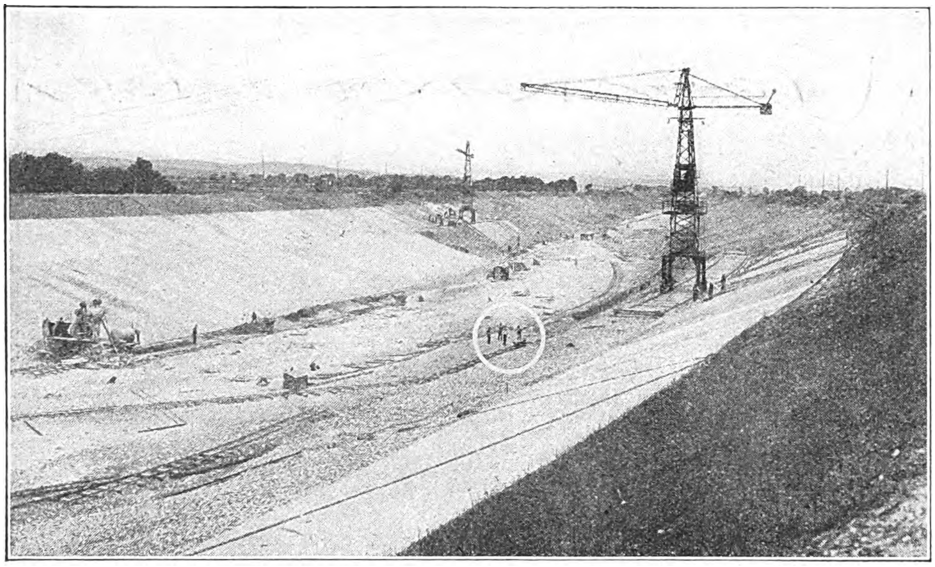
WHERE THE WATERS DIVIDE

The main weir, which diverts the necessary amount of water from the river into the head race, intake building, fish pass, and ship's pass are shown. (Dimensions indicated in meters)

THE weir has six openings—four 59 feet wide and two 32.8 feet wide. The outer openings are closed by steel roller sluice gates each 59 feet wide and 8.85 feet deep; the intermediate openings by similar gates 59 feet wide and 10.65 feet deep; and each of the 32.8-foot center openings will be closed by a double roller gate divided horizontally and having a total depth of 35.8 feet. The electrically operated hoisting machinery will be housed in a gangway which covers the weir.

At the intake building three flow openings 82 feet wide, and one 32.8 feet wide for ships, have been provided. Three undivided steel roller sluice gates 82 feet wide by 18.7 feet high and one 32.8 feet wide by 19.35 feet high, all electrically operated, control the flow through these gates. The Black River flows under the intake building through a syphon and into the Shannon.

From the intake building the head race extends a distance of about 7.8 miles to the power plant. This race was so planned as practically to balance cuts and fills, the earth obtained from the excavations being used where embankments were necessary. The dimensions of the head race are: bed 103 feet wide; maximum width at water surface 295 feet; and maximum



SOILING AND CONCRETING EMBANKMENT SLOPES

Two swivel cranes on tracks in the bed of the head race. These machines command the entire slope from top to bottom and handle earth and concrete. Note size of men in circle

depth of water 36.8 feet. The side slopes are lined with a strip of concrete that extends 23.6 inches above the highest water level and 23.6 inches below the lowest water level. The bed and the slopes below the concrete strip on each side of the tail race are lined with broken stone to a depth of about 15 inches. Three concrete highway bridges were built over the canal—one at O'Briensbridge, another at Clonlara, and the third near the Blackwater River.

The power house is being erected at the Ardnacrusha end of the head race. In this there are being installed three 38,500 horsepower vertical turbines, each of which will drive a 30,000 kilowatt generator. Three other units of the same capacity will be installed for the full development. From the head race, steel penstocks 19.65 feet in diameter have already been installed and connected with the spiral cases of the turbines. Roller sluice gates, 20.8 by 21.3 feet control the flow of water to the penstocks. These gates can be closed in 30 seconds either from the power plant or from the bridge over the intake; and are closed automatically by governors should the turbines speed up above the allowable maximum. To meet the possible necessity of draining the head race entirely a waste channel has been provided. The net fall at the power plant is from 84.4 to 102 feet, depending on the level of Lough Derg and that of the tail race which varies with the tide.

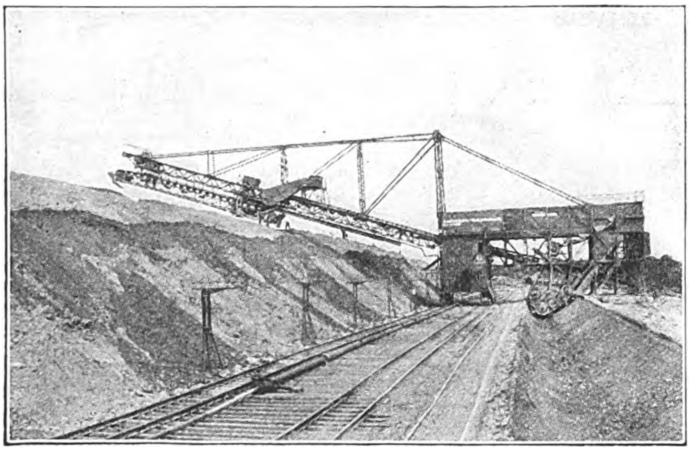
As stated before, long high-tension transmission lines of 110,000, 38,000, and 10,000 volts will carry River Shannon power through almost the entire Irish Free State. From the plant where the electricity is generated at 10,500 volts and stepped up to 110,000 volts by means of transformers, a six-conductor line extends 116 miles to Dublin while a three-conductor 110,000-volt line runs a distance of about 59 miles to Cork. These two lines, which constitute the primary distribution system, connect to transformer stations at the two cities mentioned and the power is there stepped down to 38,000 volts for further distribution. Later on, the transformer station at Maryborough will be converted into a 110,000-38,000-volt station.

At the Ardnacrusha plant, power is also stepped up to 38,000 volts thus making, with Dublin and Cork, a total of three main feeding stations for the 38,000-volt distribution system. When this latter system is finally completed, the total length of its lines will be slightly over 1000 miles.

A network of 10,000-volt transmission lines will radiate from step-down transformer stations on the 38,000 volt system, thus forming what is known as the local distribution system. On this last named system the power will be further stepped down to 380 and 220 volts at which voltage it will be supplied to consumers in cities, towns, and rural districts.

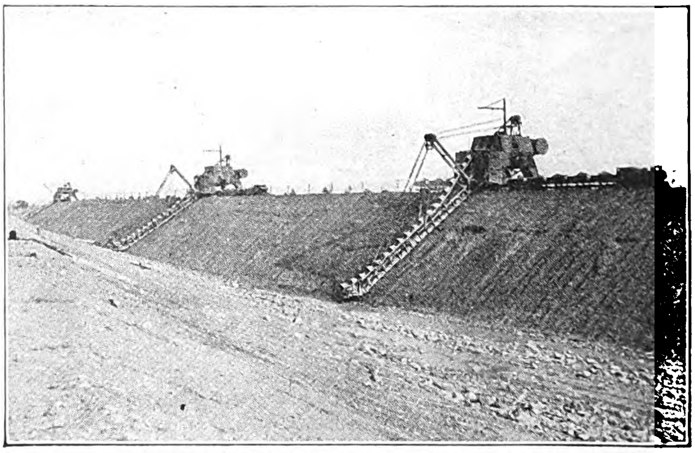
The construction of the works on this great scheme presented problems that necessitated careful planning of construction plant, selection of machinery to be used, and organization of transportation facilities. Due to the fact that something like 9,150,000 cubic yards of earth had to be handled either in excavating or filling, 1,300,000 cubic yards of rock had to be blasted, and more than 220,000 cubic yards of concrete work had to be constructed, an immense plant had to be laid out. Neither plant equipment nor the materials necessary for the work were available in Ireland and it was necessary, therefore, to import from Germany upwards of 125,000 tons of machinery, fuel, structural wood and iron, et cetera.

Incoming steamers were unloaded in Limerick Harbor by means of an electric derrick crane and two movable oil cranes erected especially for this purpose. From there the shipments had to be transported by motor truck to Longpavement and there shipped by rail on an especially built railway



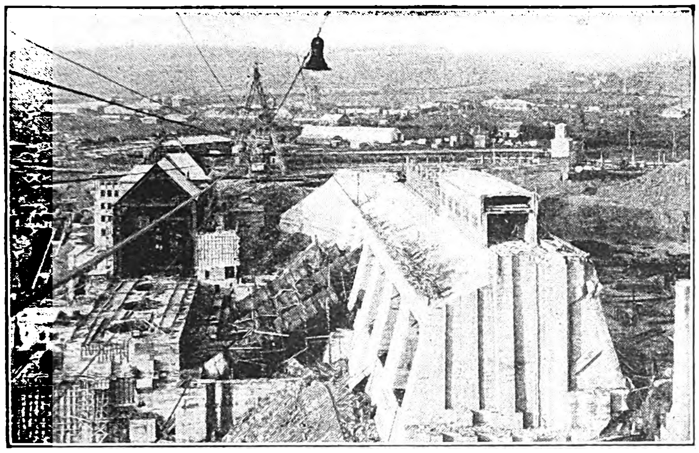
THE TREMENDOUS TRANSPORTER

This machine is described on the opposite page. It is a single machine running on tracks. The material train runs beneath it



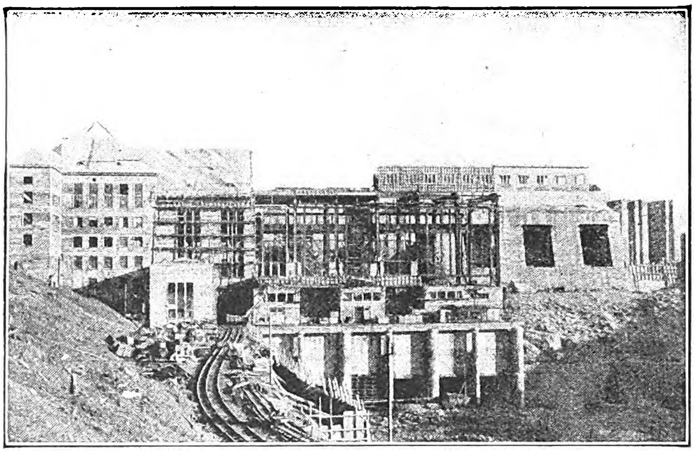
MULTIPLE BUCKET EXCAVATOR

The tracks on which this machine runs are gradually moved back as the work progresses. Material is dumped into train underneath



POWER PLANT SITE

The intake building at the power house partially complete. One of the towers of the cable crane and its cables may be seen here



THE PLANT NEARS COMPLETION

The power plant as it appears from the tail race. It will be noted that openings have been provided for three more penstocks

to the various sites. Most of the locomotives are steam driven but where the track was laid permanently for the duration of the job, they are driven by electricity.

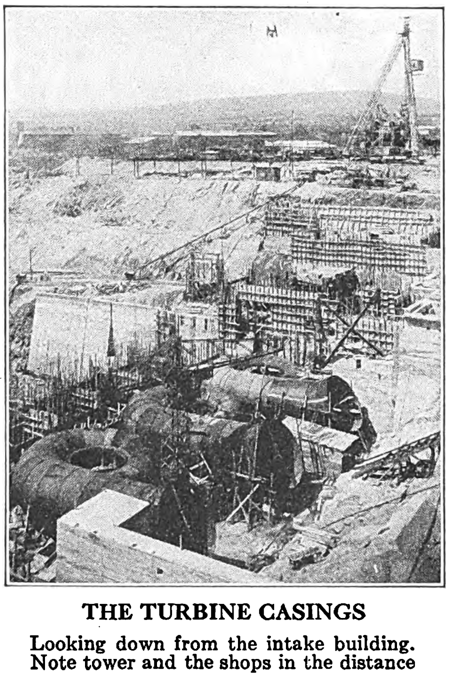
Besides work shops, material and spare parts storerooms, rock crusher, air compressor, smithy, et cetera, a temporary power station having a total capacity of 4500 horsepower in nine Diesel engine units was built. With this power available, it was possible to drive by electricity not only some of the locomotives but also the huge excavators, transporters—in fact, practically all the machinery used on the job.

SHOVEL and bucket excavators were used for removal of surface soil and digging the head-race trench. Since the top soil was unsuitable for building the embankment it was put aside and later used for surfacing the slopes above the concrete strip. The shovel and bucket excavators differ little from the types known in this country but the transporters are worth a few words of description here. Each of these is a gigantic machine weighing 250 tons. It runs on a wide double track of its own and straddles another track on which a train of dump cars may run. The material train dumps its load of earth into a small trench previously excavated by the transporter beside the track. The transporter scoops up this material and drops it on two conveyor belts which, in turn, carry it out on the arm and drop it from a height of 50 feet over a wide area.

Due to the height from which the material is dropped by the boom of this transporter, embankments formed in this manner are very well consolidated since the fall has the effect of ramming in the material. There is, however, a sprinkling device on the lower arm of the boom, to assist in settling the earth by puddling. After the roughly formed embankments are allowed to settle for a while, the slopes and top are dressed by hand labor. Following this a layer of about eight inches of top soil is placed on the top and outer slope and the inner slope is made watertight. At points where this latter operation is necessary, a layer of about 24 inches of clay is bedded in. Transporters are used for placing this surface material.

The transporters are all electrically driven, power being conveyed to each machine at 3000 volts and stepped down to 380/200 volts by means of suitable power transformers carried by the machine itself.

A SWIVEL crane, running on a track in the bed of the head race, is used for some of the slope-soiling operations, for spreading the stone, and for the concreting work. This crane has a reach of 50 feet and can lift two tons of material. It is driven by electricity. As the work performed by this crane progresses and the crane moves on, it becomes necessary to level off the track on which the crane runs. This is done by means of a roller which is pulled up the slope by a winch car which runs on a track on the top of the embankment. A 25 horsepower Diesel engine supplies the power for pulling this roller up the slope while its weight is sufficient to carry it down.



THE TURBINE CASINGS

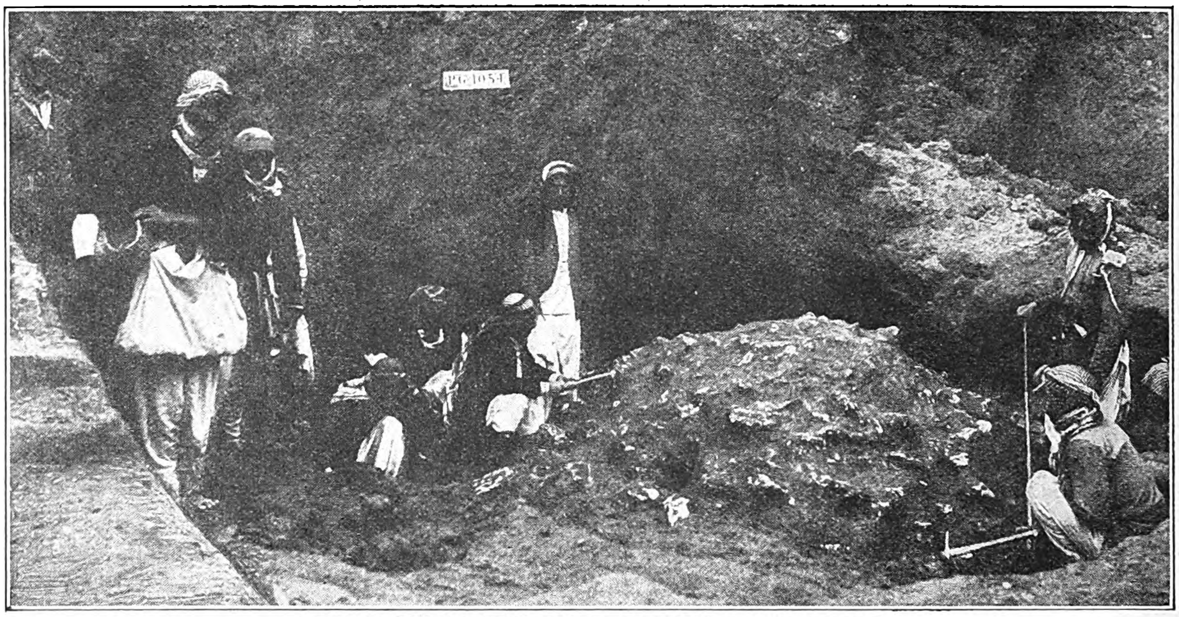
Looking down from the intake building. Note tower and the shops in the distance

The tracks of the various machines must be moved sidewise from time to time. This movement is effected by means of a track mover which is pulled along the track by a locomotive and lifts the track bodily over to the new position.

Another feature of the construction equipment worthy of description is the portable cable crane erected at the power plant for doing the concrete work. This consists of two towers, each 118 feet high, which stand on opposite sides of the power plant and are connected by a steel cable 1000 feet long. The concrete is prepared in two mixers in one of the towers, is poured into buckets which move horizontally or vertically on the cable and, since these tower supports move on rails, every part of the site can be concreted expeditiously. A similar outfit was arranged for concreting the main weir.

An average of 2500 German and Irish workmen have been employed on the partial development. Several camps with living quarters, recreation huts, and various other facilities have been maintained for these men. The magnitude of the work made it necessary to maintain offices at all the principal building sites and to employ therein a large number of engineers and office helpers. To allow constant and efficient communication between these offices, a network of telephone lines was installed. Communication was assisted by a fleet of automobiles and a motor bus and by a motor boat on Lough Derg.

ALL the work on this project, including engineering and construction, has been and is being done by the Siemens interests—Siemens Schuckertwerke and Siemens Bauunion, G.m.b.H.—of Berlin, Germany.



STONE DOME OF ROYAL PREDYNASTIC TOMB

Domes such as this covered the tombs of Scythian kings. They were constructed of brick or stone in mud mortar with a centering of wood. The beam holes for this center support are visible here in the side of the mound

New Discoveries at Ur

Excavation of Five Predynastic Royal Tombs May Explain the Origin of the Sumerian Kings of Ur

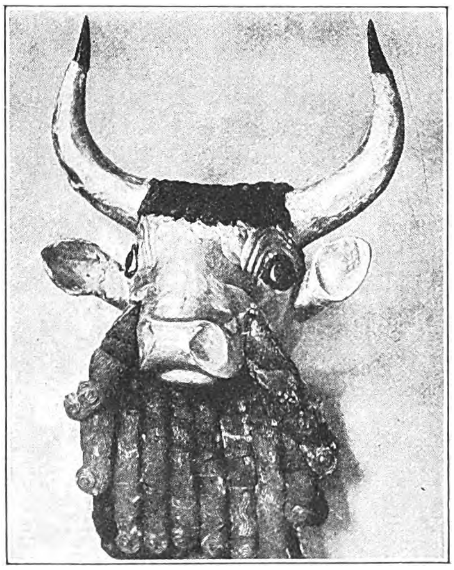
By LEON LEGRAIN, D.D., Sc.D.
Curator, Babylonian Section, the Museum of the University of Pennsylvania

LEANING over the royal tombs in the predynastic cemetery at Ur, we not only wonder at the treasures buried there, but still more we are impressed by the grim customs now revealed, the wholesale murder and burial of servants and retainers around the grave of their lord and lady when Shub-ad was a queen and Mes-kalam-dug a king in ancient Ur, more than 6000 years ago.

Five royal tombs were discovered last year. Two were intact, and three more or less plundered. Even in ancient days, the lust of gold was stronger than religious fear and curses. The complete tombs were those of Mes-kalam-dug and Shub-ad. Three more royal tombs were identified this year, and only one is still in the original condition.

THE royal burials are distinguished at once by their dimensions, the richness of the offerings, and the strange rites which accompanied them. Private persons were satisfied with a circular or oval clay coffin, or the body was laid in the earth wrapped in matting, with or without a ritual burning, and surrounded by the personal belongings of the deceased—clay, stone, and metal vessels, tools and weapons, and a wonderful display of jewels in gold, silver, lapis lazuli, carnelian, and shell. But the royal body is buried in a regular vault, built of stone and bricks and consisting of one, two, or three rooms. The tomb is covered with a series of regular brick arches, or with a dome of stone in mud mortar over a centering of wood, which throws an entirely new light on the early history of architecture.

The burial of Scythian kings described by Herodotus forms the best commentary on the royal burial of the predynastic kings of Ur and it throws a vivid light on its human and racial aspect. "When the king dies, (the Scythians) dig in the place a great square pit." The digging of the pit once finished, they cover the body with wax, open it, clean it, fill it with crushed aromatic plants, perfumes, and anis seed, and sew it again.



GOLDEN BULL'S HEAD

Below this head were found the four engraved plaques illustrated elsewhere

AFTER carrying the body from province to province across the kingdom, they bring it back to the burial ground, and place it on a state bed littered with branches, under a canopy of willow branches supported by lances stuck in the soil. "In the empty space of the pit, they place one of the king's concubines whom they have previously strangled, one cup bearer, one cook, one groom, his state minister, one of his servants, several horses—in a word, the most precious part of his riches and some gold cups." After this they fill the pit with earth.

At the end of a year they take from among the rest of the servants of the king, those who were the most useful to him. All are born Scythians, not slaves bought on the market, but chosen and ordered for his service. "They strangle 50 of them and 50 of his best horses." They open them,

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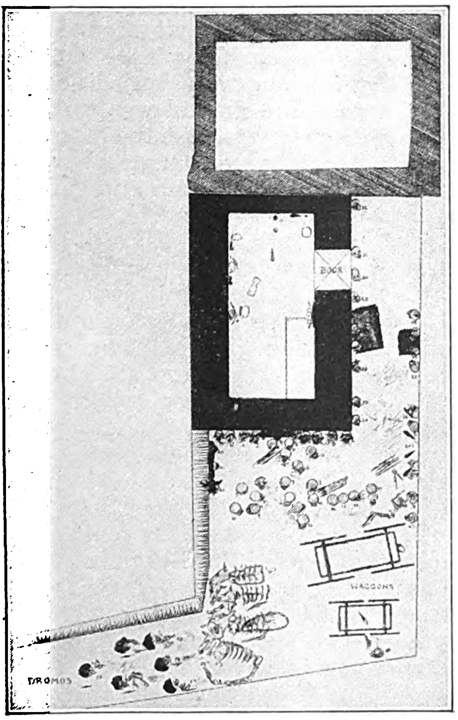
remove the entrails, stuff them with straw and sew them again. After this operation, horses and riders, mounted on halfwheels or transpierced with long pikes driven through the bodies and stuck into the ground, are left to keep their dreadful watch over the tomb of the dead king.

Such wholesale murders on the tomb of a dead king form a special feature and a racial trait of civilizations existing northeast of the Persian border. They are found not only among the Scythians, but in India, in China, in Japan, and among the Mongolian Indians in Alaska. They may go far to explain the origin of the Sumerian kings of Ur who likely came down in the past from the Elamite hills and who have much in common with the border land. The level of their tombs at Ur is 20 to 30 feet below the level of the Sargonid kings who in 2700 B.C. reigned over a mixed population of Sumerian and Semitic tribes named Akkadians. The Semites may have practiced human sacrifice, at least of their enemies, in honor of their gods, but not in order to procure servants for their dead. They never forgot the right of God to their firstborn, but they knew how to redeem him by a substitution, as in the famous sacrifice of Abraham.

At the time of the first dynasty of Ur, 3100 B.C., we find that all traces of the ancient Eastern customs prevalent among the predynastic kings have vanished. In contact with the Semitic influence, the old Sumerians lost some of their primitive rudeness. At the utmost, a clay figurine in the tomb may be the equivalent of the concubine strangled by the royal order.



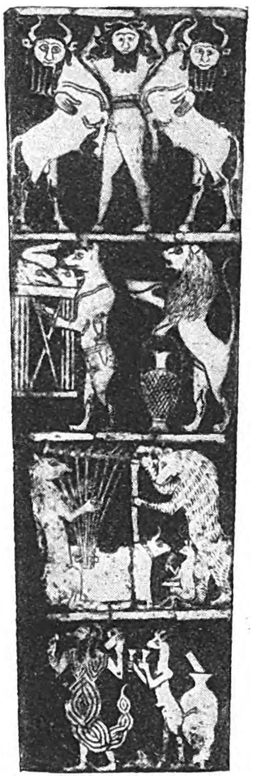
ROYAL GRAVE

Outside the tomb is the death pit, its dromos guarded by soldiers and chariots

But if we consider the art of the magnificent objects buried in the predynastic tombs at Ur, we at once realize that they represent not the beginning, but probably the flowering, perhaps the end of a civilization which had its roots in a long, long past. The Sumerian art is then already a classical art, with fixed types and school conventions. Modeling, casting, carving, and engraving have no secrets for the expert craftsmen. Their best pieces show an ideal of force and dignity, not devoid of a certain heaviness, a minute rendering of details, a love of nature and animal life. It is a subtle and curious art which likes inlay and polychromy, and delights in the mingling of colors and materials, and the blending of low and high relief with boldly salient parts in the round. Its style is surprisingly free and is not abashed by the difficult tracing of figures *en face* or the shortening of proportions in perspective. It has even an apparent sense of humour, with a deeper meaning, in scenes where animals play the parts of men and are even transformed by degrees into men. We find composite monsters: a bull with a false beard, with a human face, with the arms and chest of a man.

SHELL PLAQUES ➤

These inlaid and engraved examples of Sumarian art are completely described in the text



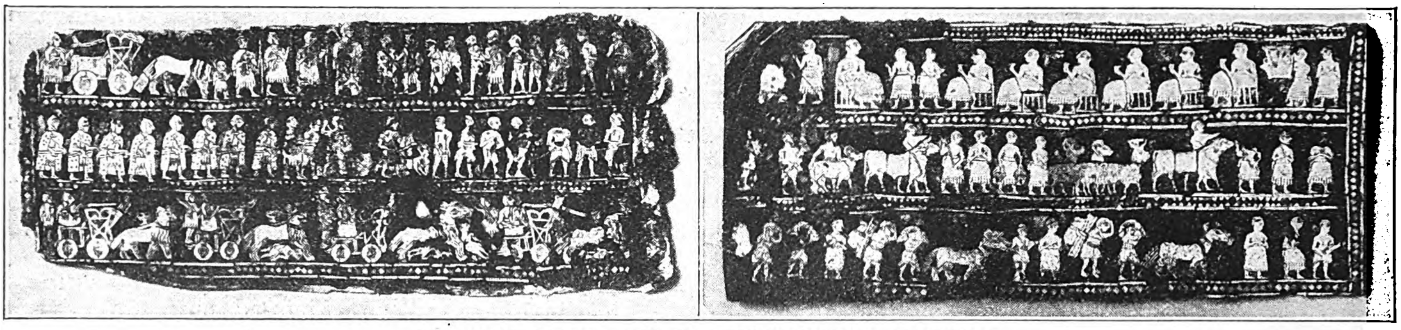
The link between the predynastic Sumerians and the still earlier Elamite civilization—about 4000 B.C.—is evident. The old Elamites never represented a god in human form, but they drew wonderful pictures of animals, especially of the wild species, and rather poor sketches of the human form. But the Sumero-Akkadians of the plain worshipped gods in human forms, with crowns, sceptres, and thrones like kings. They were no longer the hunting tribes of the Elamite hills, but they had regular institutions, city states, courts, and temples modeled on the courts. Between these two extremes, heroic hunting and regular court worship of the gods, there is a large intermediary layer of mythological figures which seems to connect them, and where we see the human god emerging from the beast while still in close contact with the primitive forces of nature.

The discovery of the predynastic cemetery at Ur has suddenly opened a door on a hitherto unknown stage of ancient human civilization, on the origin of Mesopotamian culture, perhaps on the ancestral home of the Sumerians. Nothing else so important has come of late out of the ground. It is time to satisfy our eyes and curiosity with a short inventory of the beautiful material recovered in the tombs. We will select some of the best pieces.

The tomb of Queen Shub-ad produced a very great number of objects. There were two plain oval gold bowls, one with a wire handle, one fluted gold bowl, and a gold strainer. A pair of cockle shells in gold and another in silver were among her toilet utensils. Her name was found engraved on her lapis cylinder seal. There were also 18 silver tumblers, fluted and engraved, a silver jug, a silver bowl with a gold drinking-tube and another drinking-tube covered with lapis, many silver bowls and saucers, about 30 stone vessels and many in copper. With these was a very finely modeled bull's head in silver with shell plaques on the chest, which had probably decorated the front of a harp.

The body of the queen lay on a wooden bier, almost hidden beneath two silver lamps. Around the knees were garters of lapis and gold beads; on the hands were ten gold rings. The upper part of the body was entirely covered with a mass of beads in gold, lapis, cornelian, and agate, which had formed a beaded cloak fastened over the right shoulder and arm. The fastenings were composed of three large gold pins with lapis head, each attached to a big lapis seal. On the right arm were three fish amulets, one in lapis, two in gold, a gold amulet in the form of two seated antelopes, and one of a reclining calf made of lapis and hung on big beads of lapis and agate.

Around the neck was a "dog-collar" made of gold and lapis triangles. On the head was an elaborate headdress worn over an artificial wig. A broad gold ribbon passed several times round the head. A triple string of beads from which hung large gold rings ran across the forehead and above this were a second string of big mulberry leaf pendants of gold, and a third string of gold and lapis beads with small drop pendants, long slender willow leaves of gold in sets of three and gold flowers with inlaid petals of blue and white. From the back of the head rose a gold comb of Spanish form, like a pin broadening to

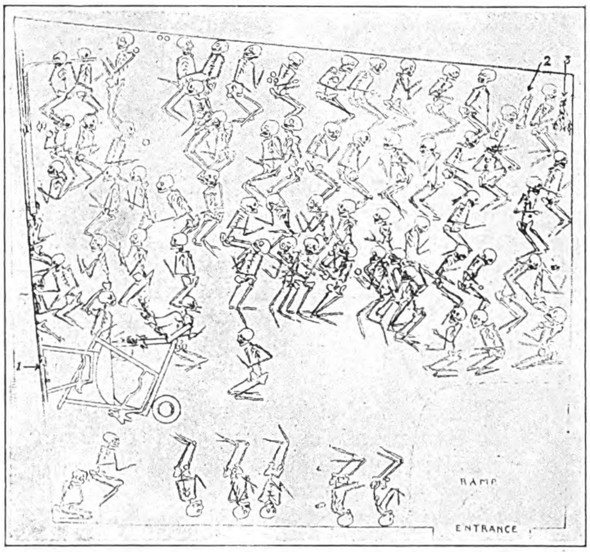


WOODEN STELA INLAID WITH SHELL MOSAIC

At the left is shown the front of the stela, illustrating the war scenes. At the right are the peace scenes which are on the back of this interesting record. The pictures follow a regular sequence of events. They are fully described in the text on the opposite page

a triangle having seven long thin points connected by wires and at the end of each point a large rosette with inlaid center.

By the side of the bier was a unique diadem. It is a fillet of thin leather to which were stitched minute beads of gold and lapis covering the whole surface; against this background were small gold rosettes, palmettes of thin twisted wire, branches in gold, with gold and carnelian pods, bunches of pomegranates with three fruits and three leaves, ears of corn in gold, and four pairs of seated gold animals, stags, rams, antelopes, and bearded bulls. It is a marvelous and delicate piece of work.



PLAN OF DEATH PIT

Drawing showing relative position of objects. At 1 are the harps and at 2 and 3 are the statues of golden rams

The earrings worn in the ears are spirals of gold wire. But in the hair under the gold ribbon headdress, there were enormous earrings in the shape of crescent moons, more than four inches in diameter.

The "death pit" around the tomb was littered with bodies. The ladies of the harem wore the identical headdress of gold ribbons, wreath of beads and mulberry leaf pendants, gold earrings, and a silver comb shaped like a hand with at the tip of every point a rosette having inlaid petals of gold, shell, and lapis.

AGAINST the side of the shaft were two bulls' heads, a part of harps otherwise entirely decayed; one is of copper, the other of gold and lapis with the hair, beard, eyes, and tips of the horns of lapis. This is a wonderful example of ancient Sumerian art. The head is hammered from a sheet of thin gold over a wooden core. The horns and ears are made separately and attached. Each tress of the beard is cut apart and set in bitumen on a wooden board inserted in a cut made below the chin. The inlay and polychromy of the materials are in the spirit of the old art. The result is very striking. The animal form is original and powerful.

The false beard is a mythological trait borrowed from an extinct race—the bearded bison of Elam, celebrated in the heroic story of the famous hunter, Gilgamesh. His legend was sung to the tunes of the golden harp. Below the golden head were found four engraved plaques unrivaled for the energy and beauty of the drawing, and for the richness in mythological subjects. The first represents Gilgamesh, the famous king of Erech, the perfect athlete, nude except for a belt, and showing his superhuman force by grasping two human-headed bisons.

An extraordinary ritual scene is figured on the second panel. The butcher priest is an animal, a mastif with belt and dagger—carrying a small table, a cane altar on which are piled choice pieces, a leg of lamb, a calf's head, and a bear's head. The dog has human hands. He is followed by a splendid lion rampant, carrying a lamp and a jar protected by a reed network like Italian *fiaschi:* the fire and wine of the sacrifice.

In the next panel a seated donkey plays on a harp upheld by a dancing bear; a seated jackal drums on a board and shakes a rattle: the music which always accompanies the ritual.

Finally, two mythological dancers complete the picture: a scorpion man and a rampant chamois, both with human arms and shaking rattles and cymbals. Nothing so important to the study of Sumerian art and history has hitherto come out of the ground.

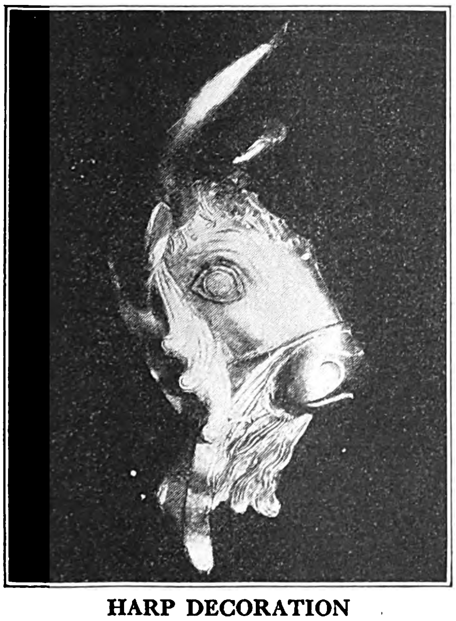
A gaming board, complete with its two sets of gaming pieces and dice was among other important finds. The shell plaques were engraved with animal scenes. One set of dice is of shell with lapis dots, the other of lapis with gold dots. A second very fine gaming board was found in a plundered tomb. All the shell squares are engraved with beautiful animal scenes, framed in blue lapis and mounted on silver. A complete board where the squares are decorated with geometrical designs was discovered the previous year and is now in the British Museum. Games and music were relaxations welcome to the souls of the dead rulers. A remarkable silver boat about 24 inches long found in the same tomb, complete with its oars and awning support, supplied the transportation across the dark waters of the kingdom of death.

IN the death pit around this plundered tomb of an unknown king were buried 58 persons. The ground was carpeted with mattings. At the entrance, six soldiers were on guard, spears in hand, their heads still covered with copper helmets. At the foot of the ramp, two heavy four-wheeled chariots had been drawn up by their teams of three oxen. The bulls were harnessed with reins made of large silver and lapis beads, silver rings were attached to their noses, and silver collars were around their necks. A mascot in the shape of a passant bull surmounted the rein-ring. Grooms and drivers lay dead along side their teams.

But the best was still to come out of a large plundered three-chamber tomb, one of the earliest yet found. The thieves had overlooked some good pieces—two imitations of ostrich eggshells, one in silver and one in gold (both had been encrusted with shell, lapis, and red stone), and a gaming board made of shell plaques framed in lapis and set in silver. But the most important object was a stela made of wood, 30 inches long. Both sides and the ends are covered with mosaics of shells cut and engraved and fixed on a background of lapis. Each side has three registers divided and bordered by a minute diamond pattern in white, red, and blue. It seems almost impossible to satisfy our curiosity by looking at the world of little figures crowded in the six registers and the two triangular ends. The front represents war scenes, and the back peace time. The king, the war lord, is a tall figure in the middle of the upper register. He carries a club and a lance. Prisoners are brought unto him headed by the chief of the defeated enemies. The king has alighted from his chariot and is followed by his officials. All wear copper helmets, lances, and axes. Their dress is a kilt with long laps, a plaid thrown over the left shoulder. All are shaven and shorn and barefooted.

THE chariot has four wheels, side and back panels, high front, and a curved pole supporting a rein-ring before its junction with the yoke. A groom, whip in hand, leads the team. The henchman follows on foot holding the reins and a battle-axe. The reins lie in a notch cut at the top of the front. A quiver full of darts and lances hangs at the left. A leopard skin is thrown over the back panel and the step on which stands the henchman during the action.

The team is four asses. Braids of hair are attached to their collars. The reins are tied to rings in the animals' noses. The wheels are made of two semi-circular pieces joined by copper clamps round a central core. The axle, solid with the wheels, turns in a groove below the body of the chariot. Copper pins secure the connection with the wheels. It is remarkable that the wheel was used at Ur 1500 years before it was imported into Egypt The wheel-band was probably made of bronze sections.



HARP DECORATION

This golden bull's head ornamented one of three harps discovered recently at Ur

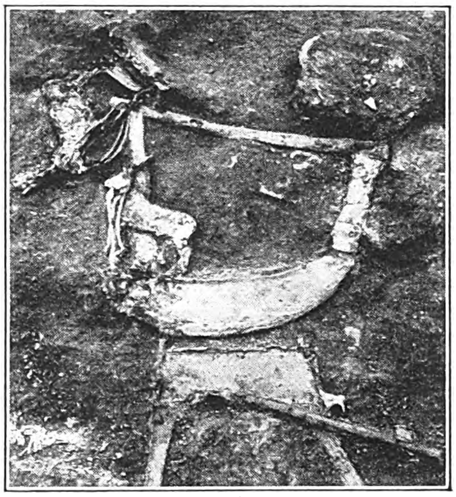
The second register shows the infantry in action, the third the charioteers. The legion has formed a solid rear line. All wear scalloped kilt, helmet, and mantle, and they have lowered their lances. The front line is engaged. The enemies are prostrate, wounded, stripped, bound, captive, or in flight. The bodies of the enemies are nude and cut by wounds. The charioteer scene is a pure delight. It begins with a lively pace and finishes in a mad charge.

The peace scene is not less interesting. The king is seated with his sons or officials and drinks a cup of the best, while a harp player and a singer recite the great deeds of the battle. Below, a pageant of servants bring the requisites of the feast: bulls, goats, ram, lamb, and four big carp. The procession is closed by teams of asses with their drivers and pack carriers. To the victor belong the spoils. This memorial or standard is an unparalled work of art, an invaluable historic document.

THE last campaign, which ended at the beginning of February, has revealed new tombs, shafts, and death pits. One domed chamber was found intact. The clearing of another death pit has given astonishing results. In a space of about 25 feet square were piled the remains of 74 persons, most of them women. Many of them wore the well known court ornament of Queen Shub-ad: gold ribbons and wreaths of gold leaves, beads of gold and lapis and carnelian, and tall Spanish combs spreading into flowers with inlaid petals. What a strange and impressive show when the warm bodies were laid on the carpeted soil, dressed in their purple mantles and golden crowns. Perhaps they were the votaries attached to the court of the high priestess, herself a sister or daughter of the king.

In one place four harps were piled together. Their sounding boxes were decorated with inlay. Mosaic work and gold bands covered the uprights. The largest had its top beam made of silver and had in front a magnificent gold head of a bearded bull. The beard attached by a string and flowing in large wavy curls below, suggests the majesty of the famous Moses of Michelangelo. Below this head are the usual engraved plaques, the lines of the design being filled with red and black in sharp relief on the white ground. The second harp is of silver and is decorated with a silver head of a bull without beard, perhaps a cow. The box suggests the form of a crouching animal bellowing in pasture land when the eve is cool. The third harp is boat-shaped and is decorated with a statue of a stag standing amidst branches. The whole is of silver. Another copper statue of a stag belongs to a harp which has entirely perished.

In another corner of the pit, two statues of rams in the round are not less remarkable. They are masterpieces which instinctively recall the works of Benvenuto Cellini. Two rams of gold, silver, lapis, and shell pieces cut to imitate the fleece, are represented standing on their hind legs, their front legs caught among branches and flowers of a shrub made of gold, silver, and inlaid stones. The two sockets on the upper part of the statues suggest that they were used for support of what we could fancy were wax candles at a royal feast, if such profanities were not a little frivolous while talking of the grim old Sumerian antiquity.



SILVER HARP

This boat-shaped harp is decorated with a statue of a stag. The whole is of silver

AND why not after all? The newly revealed civilization has many points by which it appeals to the modern mind and seems close to us. The same human delight in beautiful things and forms; the same pleasure in glittering gold and silver and luscious white shell; the same craving for ornaments, gold, lapis, carnelian beads, gold crowns, earrings, necklaces. The same time-honored crafts of the smiths and jewelers; the same refinements of songs and music; the same relaxation of dice and gaming boards; the same passion for war and hunting and driving in state over the plain. But we stop and feel strangely impressed by their creed and belief of life beyond death, and we are distressed by the murder of so many human victims. But is not life arising from death and are such beliefs so far from many modern creeds that life is not worth while without sacrifice? The history of religions and of anthropology has much to learn from the predynastic cemetery of Ur.

Electric Thermometers for the Stars

The Eye Is No Judge of the Heat which Each Star Radiates, but a Thermo-Couple Measures It with Precision. The Hotter a Star the Greater the Proportion of Its Radiation We Perceive Visually, but the Very Hottest Stars Radiate Mainly in the Ultra-Violet

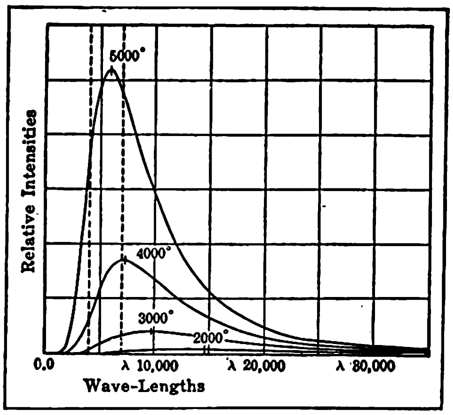
By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

"COLD as the north side of a January gravestone by starlight" is a phrase which recalls the extravagances of Yankee humor rather than the truths of science, yet a real if familiar physical fact is recalled by the words. The stars send us no perceptible warmth. Indeed the starry night is often a cold one because the clear air allows heat to escape from the earth's surface into space, while nothing comes back from its depths to redress the balance. Yet when we substitute the delicate equipment of the modern laboratory for our comparatively insensitive skin we find that even the far-off stars do send us heat, although very little of it.

TO detect the existence of this heat radiation was a few years ago a *tour de force*. Today it can be measured with precision; not merely for the brighter stars, but for stars invisible to the unaided eye. Pettit and Nicholson, who have been working for a long time upon this problem at Mount Wilson, have recently published the results of a five years' campaign. Something has been told of the work in these columns before, but there is much more to tell now, and much that is of great interest.

Needless to say, the great 100-inch telescope has been used to concentrate the greatest possible amount of starlight, but even this would be of no avail if the receiving apparatus were not of almost incredible sensitiveness. After many trials—in both of the familiar senses of the word—the electrical heat measuring system has been perfected. The star's rays, passing through a transparent window into an exhausted receiver, fall upon a tiny thermo-couple—the junction of two wires of different alloys. If this is heated an electric current is set flowing, which passes through a delicate galvanometer.

The wires which are actually employed are hardly more than a thousandth of an inch in diameter. The whole thermo-couple, with two junctions so arranged that shifting the star's image from one to the other reverses the current and doubles the effect, weighs less than one 600th of a grain, and the part which is heated at any one time by the star's radiation weighs only one 2000th of a grain. The heat from Betelguese, which sends us more than any other star, even when concentrated by the great mirror upon this tiny speck, raises its temperature by less than one 60th of a degree. This sets up a current of only one 7,000,000th part of an ampere in the circuit, but so sensitive is the galvanometer that the recording spot of light swings through 18 inches! With this perfected equipment, radiation which sufficed to heat the receiver by less than one 100,000th part of a degree has been measured, and any star which can be seen with the naked eye is within the reach of the apparatus.



From Russell, Dugan and Stewart's "Astronomy." Courtesy Ginn and Co.

HOW MAXIMUM RADIATION SHIFTS

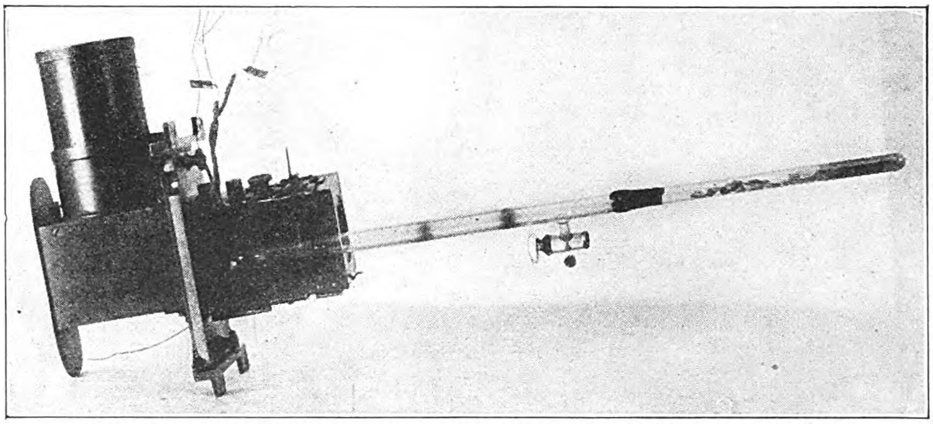
This diagram shows how maximum intensities of radiation shift toward the ultra-violet as temperature rises. The two vertical, dotted lines delimit the visible spectrum. As Dr. Russell explains, a curve for 20,000 degrees would have a maximum still farther to the left, in the ultra-violet, but our atmosphere would cut off most of this short radiation

More than a hundred stars (124 to be exact), including some of almost every known variety, have thus been measured and the results are of manifold interest. Perhaps the most striking of these results is the great difference in the amounts of heat which we receive from stars which to the eye appear of the same brightness. If we could *see* heat, that is, if our eyes were equally sensitive to radiation of all wavelengths instead of being confined to one narrow band, Betelguese would rank as the brightest star in the sky, since it sends us again as much heat as Sirius. Antares, too, would appear a little brighter than Sirius, although to our eyes, as they are, it looks only one twelfth as bright. Canopus would come fourth in the list; then Gamma Crucis; Arcturus; Alpha Herculis; Aldebaran; and, at its maximum, the variable star Mira.

ONE who is familiar with the stars will notice at once that most of the stars upon this list are *red*—and here we come upon the most conspicuous peculiarity revealed by the heat measurements: the white and yellowish white stars such as Procyon, Canopus, Sirius, Rigel, and even the bluish stars of Orion's belt, send us heat nearly in proportion to their light. When we come to the yellowish stars like the Sun or Capella we get 50 percent more heat for the same amount of light. A star like Arcturus (class K) sends us more than twice as much heat as a white star of the same brightness; a red star like Antares six times as much; and from Alpha Herculis, which is very red, we receive 50 times as much heat as from a white star that looks equally bright to the eye. It is, however, the total heat and not the light that comes from the stars, that is obviously the more fundamental quantity. So we will do better, then, to reverse our statement and say that the white and yellowish stars all send us about the same amount of light in proportion to their heat; the Sun two thirds as much; Antares about 15 percent; and Alpha Herculis only 2 percent. When put in this way we recognize that the differences have to do with what the illuminating engineer calls "luminous efficiency," and the every-day purchaser of electric lamps knows as "candles per watt."

Our familiar lighting devices are far from ideal. An incandescent lamp, indeed is a pretty efficient apparatus for turning electrical energy into heat—as those of us know to our cost who have left a lighted bulb too near to combustible material. This heat has come from the hot filament, through the vacuum to the wall, and hence by radiation. But only a smallish fraction of it was carried by the short waves which affect our eye, the rest being borne by longer, invisible waves. The higher the temperature of the source the greater the fraction of the whole energy carried by the short light waves. Hence, the history of progress in electric lighting has been largely one of development of refractory materials which could be run at a high temperature without wearing out.

AMONG the stars exactly the same principle is in evidence. The very same equations which enable an illuminating engineer to calculate how much gain in efficiency he will get by the use of a filament that can be run at a higher temperature, permit the astronomer to calculate from the observed relation between the light and heat emitted by a star, how hot its surface may be. These calculations confirm the conclusions which have already been drawn from the color of starlight, and show that the scale of stellar temperatures begins about where that of laboratory temperatures leaves off.

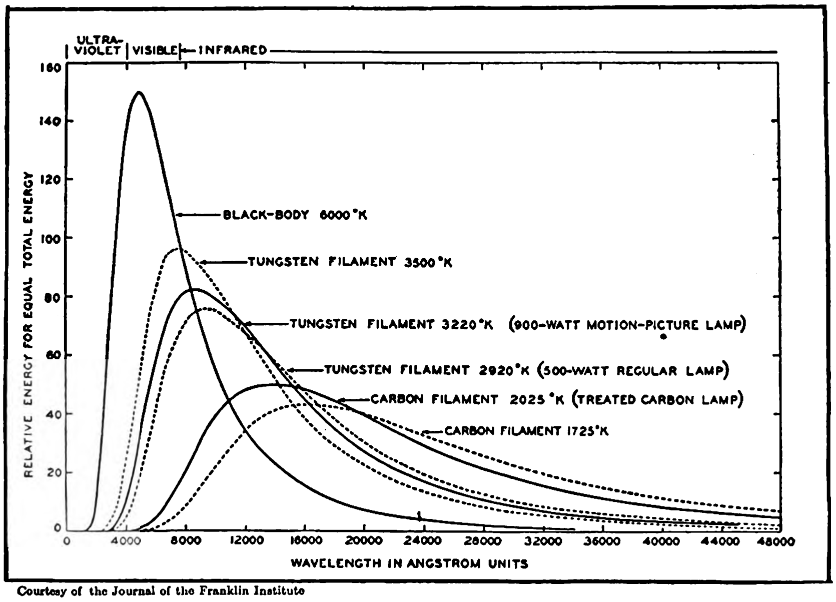


THERMO-COUPLE FOR DELICATE RADIATION MEASUREMENTS

This is not the apparatus used by Pettit and Nicholson, but a similar piece devised and used by Dr. W. W. Coblentz of the Bureau of Standards, in research on planetary temperatures

A very red and cool star like Alpha Herculis has a surface temperature of about 2300 degrees, Centigrade; while a moderately red one like Betelguese is at 2800 degrees, which is not far from the highest temperature attainable with most electric furnaces. As the temperature rises higher the proportion of the energy which is radiated within the limits of the visible spectrum rapidly increases, until at about 6000 degrees the region of strongest radiation from the stars' surface coincides with that in which the radiations affect our eyes most powerfully.

Here we might expect the luminous efficiency to be a maximum, since for still hotter stars an increasing fraction of the radiant energy moves over into the ultra-violet—waves too short for the eye to see. If we could observe from a station on the moon there is no doubt that we would find this to be the case, but our terrestrial measures have to be made through miles and miles of air which is quite opaque to ultra-violet light only a little beyond the limit to which the eye can see. Hence, the short-wave radiation fails to reach our instruments, as well as to stimulate our optic nerves, and the falling off in the ratio of light to *observable* heat, although present, is small.



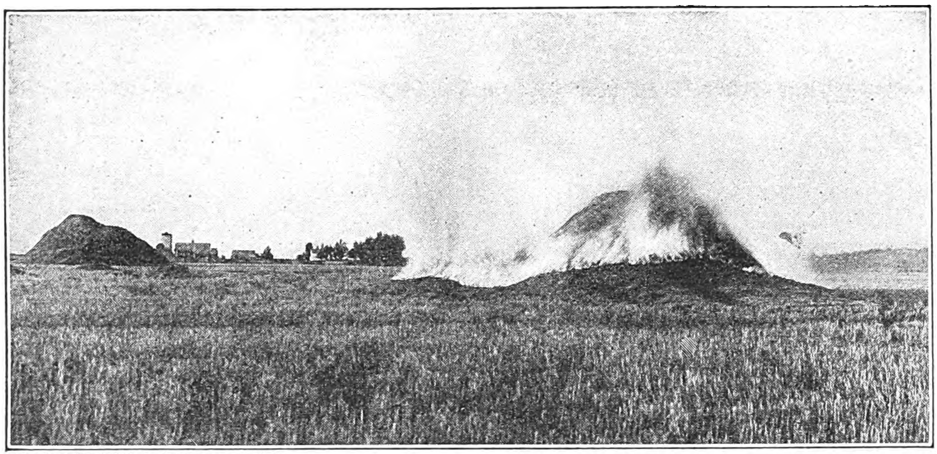
Courtesy of the Journal of the Franklin Institute

GETTING MORE "CANDLES PER WATT"

Compare with diagram opposite. In both, an increase in temperature shifts the maximum of radiation toward shorter wavelengths (Wien's law of displacement). This explains why tungsten filaments, which will withstand higher temperatures, give more candles per watt than carbon filaments. A perfect radiator ("black body") would be still more efficient (see curve) if it could be heated to 6000°K or "absolute" (5727°Centigrade) without melting. The diagram above was originally published by Dr. M. Luckiesh, to prove that the most penetrative source of infra-red therapeutic rays is a tungsten filament lamp, our bodies being virtually opaque to waves longer than 14,000 Angstrom units; but it serves equally well to illustrate Dr. Russell's point about shifting maximum radiation

Theory once more comes to our aid and shows how much more heat we would receive if we could get outside the atmosphere. The difference is least for a star of about 4500 degrees temperature, for which 70 percent of the heat gets through the atmosphere. For cooler stars the difference is not great, the transmission being 50 percent for a temperature of 1900 degrees. But if the star's temperature is 10,000 degrees, only 40 percent of its heat gets through; at 15,000 degrees the transmission is 21 percent, and at 20,000 degrees only 11 percent. The stars of Orion's belt are probably at least as hot as this; hence if we could measure their radiation without interference we would doubtless get almost ten times as large a reading as we actually do.

APPLYING this correction we could find at last, when we know the distance of a star, how much heat it sends out into space. This, of course, is the real measure of the star's greatness and it is interesting to note that, judged by this criterion, the greatest known stars are much alike, whatever their surface temperature. Among the long list given by Pettit and Nicholson the outstanding stars are Alpha Herculis, with a surface temperature of 2300 degrees; Antares (2700); Alpha Cygni (10,000); Rigel (13,000); and Epsilon Orionis (12,000)—the brightest in Orion's belt.



Courtesy North Dakota College of Agriculture

FIRES DOT THE PRAIRIES AFTER THE HARVEST

America produces about 48,000,000 tons of grain a year; consequently there are about 96,000,000 tons of straw. Much of this is burned, although it has high commercial value

Farm-waste Profits: Best Farm Relief

Utilization of Waste Is Seen As the Surest Hope of the Farmer

By ROBERT STEWART, Ph.D.
Dean of the College of Agriculture, University of Nevada

THE farms of America are producing more food than our people can consume and the surplus production of farm products has created a vital problem which is pressing for solution. Attempts are being made to solve this problem by political action and its solution was a dominant political issue in the last presidential election. Whether or not any real help will be afforded farmers by government action, however, has yet to be decided.

The capacity of the human stomach also is limited and the changing dietary habits of the people are actually causing a decrease in the consumption of our common foods. The demand for our agricultural products in foreign lands is markedly limited by the ability of these people to buy in any large quantity. New markets for agricultural products as food cannot be created and there is no solution for the farm problem in that direction.

Controlled production of farm products is far more difficult than the control of production in industry and is probably not feasible because of the large number of farmers concerned and their unorganized state.

There is one important way in which relief for this situation may be obtained for the farmer and that is in the development of new uses for farm products. The corn plant consists of leaves, tassels, silk, roots, cobs, and grain. The grain alone is regarded as of value and that only for livestock. The remainder largely goes to waste. The feeding of seven eighths of the grain to livestock is an extremely wasteful process, as wasteful as burning coal in a furnace to produce heat. The grain of corn consists of definite organic chemical compounds which have great commercial value. It contains cellulose, starch, sugar, protein, and oil. The farmer is therefore a producer of organic chemical compounds. He now produces food for human consumption: he must produce raw materials for industry and thus feed factories as well as human stomachs.

ON the hundred million acres of corn land in America, 200,000,000 tons of cornstalks are produced. These stalks will yield over 30 percent of high-grade cellulose of high purity capable of being converted into the best artificial silk and motion picture films. Paper and lumber substitutes also can be made from the stalks. At Danville, Illinois, cellulose for films and rayon for cloth is now being produced commercially from cornstalks. Celotex, a lumber substitute, is produced from the fiber of sugar cane, a farm waste product, and one company has been organized in Iowa to produce wallboard from cornstalks.

There are also produced 20,000,000 tons of corncobs which now largely go to waste. On being submitted to destructive distillation, however, they yield an adhesive material suitable for briquetting, and furfural which has innumerable uses. In the presence of air, furfural readily darkens and resinifies, thus producing material of value in the making of phonograph records, pipestems, and radio loud speakers. It is an antiseptic similar in nature to carbolic acid. It is, therefore, of great value as a germicide and as a fungicide. It penetrates wood very readily and is of value in dressing the wounds on valuable trees. It is also used to flavor tobacco. Owing to its solvent action and high power of penetration and low toxicity it is used as a solvent for dyes and leather dressings. It is an excellent solvent for nitro-cellulose and finds use in the lacquer industry. It is an excellent fly repellent and is used for this purpose with marked success. This important product may easily be prepared from corncobs. The corncobs and cornstalks make up three fourths of the farmer's corn crop and thus constitute valuable by-products.

The grain of the corn also contains valuable organic chemical compounds. The germ of the corn kernel contains a valuable cooking oil and also paragol, a rubber substitute of value for making bath sponges. The germ from a bushel of corn will yield a pound of oil in addition to a certain quantity of the paragol. The residue of the germ is still valuable as cattle feed.

THE hull of the corn kernel yields phytin, a food of great value to people suffering from nervous disorders as it contains 21 percent of assimilative organic phosphorus. The hulls from a bushel of corn still provide 14½ pounds per bushel of protein valuable as a tissue builder for livestock. The endosperm of the corn kernel contains starch. A bushel of corn will yield 33 pounds of laundry starch. Or the starch may be converted into dextrose or corn sugar which has a wide and growing use in bread making, ice cream manufacture, and the preserving of fruit.

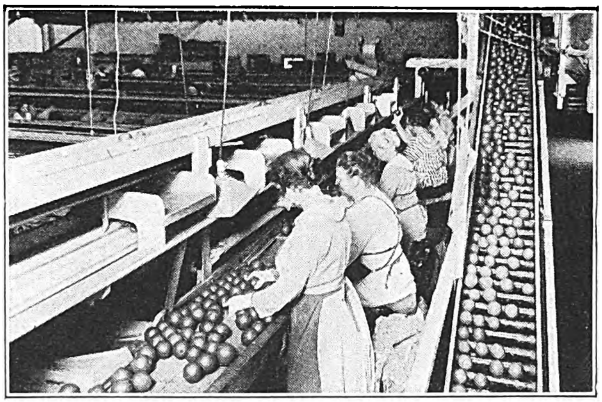
Over half a million pounds of corn sugar are being used in the baking industry per day and its use is constantly growing. A bushel of corn will yield 25 pounds of corn sugar and, in addition, 15 pounds of corn syrup. At the present time we are importing 58.7 percent of our requirements for sugar from foreign sources and paying 360,000,000 dollars annually for it. The greater use and development of our corn-sugar industry will retain much of this money at home. The corn may also be converted into solvents for use in the automobile, motion picture, and other industries, for the production of films, lacquers, artificial silk, leather, dyes, and numerous other common compounds. A bushel of corn will yield 11 pounds of solvents consisting of 60 percent normal butyl alcohol, 30 percent acetone and 10 percent ethyl alcohol. Two factories, one at Terre Haute and one at Peoria, are conserving 30,000 bushels of corn daily—10,950,000 bushels per year—for the production of these solvents. The residue contains all the protein and most of the other essential food elements and is of value as live-stock feed.

There are 25,000,000 dairy cows in America and they produce 2,500,000,000 pounds of butter per year. For every pound of butter produced there are two pounds of other solids in the milk, most of which now goes to waste. These solids can be utilized in industry and, in a few notable instances, marked success has been achieved in their utilization. The casein in these milk solids is used to make imitation ivory which finds an abundant use in the manufacture of toilet articles such as combs and hair brushes and various other attractive articles for milady's boudoir.

The casein is also used as sizing for various types of material including the production of the sheen on paper. In 1926 over 78,000,000 pounds of milk solids were recovered from the milk and marketed successfully. The recovered dry skim-milk offers an excellent means of overcoming the common deficiency in the diet of the average American family by providing the lime and phosphates so essential to health and too often lacking in our more common foods. There is a ready and growing market for this waste product of the farm.

On the grain fields of America there are produced about 48,000,000 tons of grain each year consisting of wheat, oats, and barley. The grain is used largely as human food, live-stock feed, and in industry. For every ton of grain produced there are approximately two tons of straw produced which now largely goes to waste. If the straw is not actually destroyed by fire, it is used as roughage for feeding live stock and as such has only very indifferent value. This waste material is a valuable source of many important organic compounds of value in industry. It contains cellulose of high purity. It contains lignin, a compound which probably has as important a use in industry as does coal tar, the base of all our important dyestuffs.

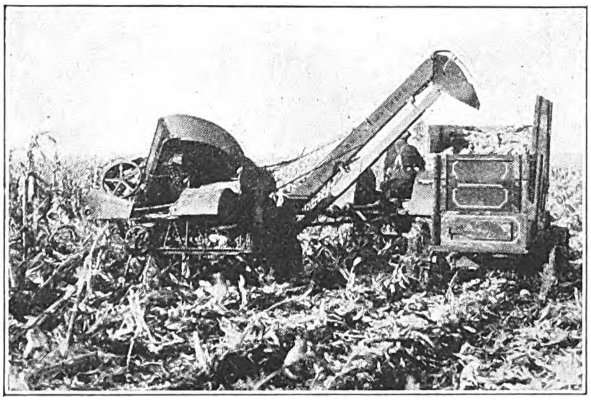
It has long been known that an abundance of gas may be obtained from wheat straw and various attempts have been made to use it industrially. When straw is submitted to destructive distillation, that is, distillation in the absence of air, various important products are obtained. When straw is burned in the open air, about 40 pounds of ash per ton of straw is all that remains. When straw is submitted to destructive distillation, about 1600 pounds of valuable organic chemicals per ton are recovered, including disinfectants, fly spray, straw oil, roofing and damp proof material, straw carbon, paints, and auto top dressing.



Courtesy California Fruit Growers' Exchange

THROWING OUT THE CULLS

Citrus fruit culls—poorly colored, small oranges, lemons, et cetera—are now being fully utilized



200,000,000 TONS

That quantity of cornstalks are produced yearly in America. From them can be made many products

At St. Joseph, Missouri, a modern pulp and board mill has been erected for the purpose of manufacturing insulating board from wheat straw. It is claimed that the long, tough, cellular fibers in wheat excel all other fibers for the production of insulating material of great strength.

There is abundant demand for insulating material of this type in the construction of houses, refrigerators, and other devices when resistance to heat and cold are required. Paper board from wheat straw has great structural strength, is virtually fire resistant, and is unexcelled for its sound-deadening qualities.

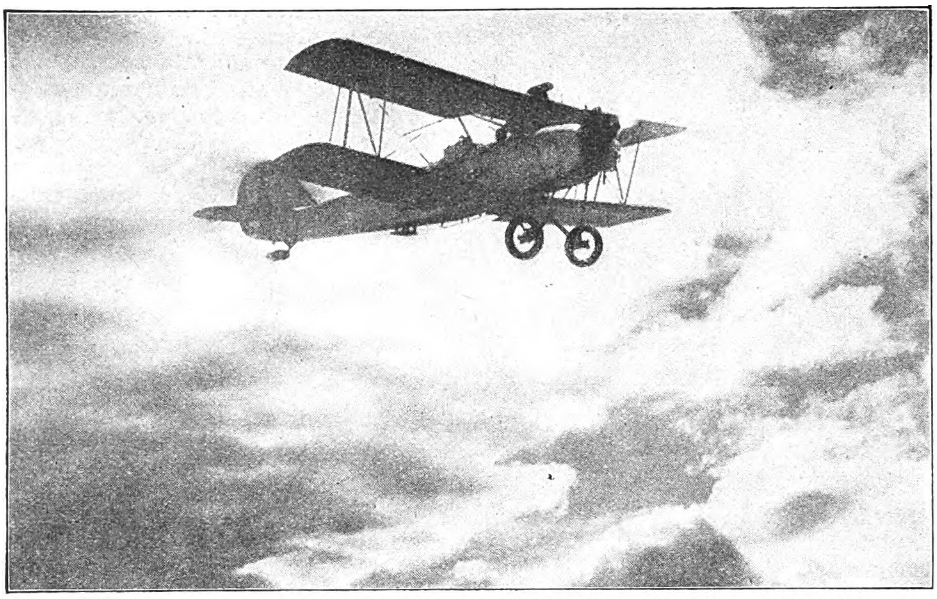
When the straw is used more generally for these purposes it will bring in as much to the farmer as he now receives for his grain alone. The farmer's profits will be materially increased and the useful commodities obtained from the straw will contribute to the sum total of human happiness.

Cotton seed was once an offensive waste product in the ginning of cotton. It was necessary in many communities to pass laws governing the disposal of this waste product as a measure of health protection. Cotton-seed oil is now extracted from it and the toxic principals removed so that now cotton-seed meal is a valuable cattle feed. This former waste product is now valuable and adds from 10 to 20 dollars to the price the farmer receives for a bale of cotton. The cash value of this waste product of the farm in 1926 was 154,000,000 dollars! Chemists have found that cotton-seed bran, as well as peanut hulls, can be converted into an acid which is cheaper than lactic or tartaric acid and can be used for soft drinks, candies, and in tanning leather. The bran is sometimes used as cattle feed, but many tons of bran and peanut hulls are wasted yearly.

The California Citrus Exchange has erected a factory at Corona, California, for the disposal of surplus lemons which are utilized by being converted into citric acid, pectin, and lemon oil. The poor quality citrus fruits are thus removed from the market and the growers' profits increased by the creation of a demand for quality products as well as by utilization of unsalable fruit. The packing house industry boasts that in the conversion of the hog into bacon everything is utilized except the squeal. The citrus industry does better than this: they utilize everything from the orange, including the oil which produces the flavor!

In the raisin industry in California the unsalable raisins, stems, and seeds are used to produce fruit sugar sirup which finds a ready sale. Surplus grapes by the trainload are converted into industrial alcohol.

The industrial utilization of farm crops is only in its infancy. The farmer, by the aid of soil, sunlight, moisture, and plant food, is a manufacturer of definite organic compounds through the growth of plants. He produces cellulose, oil, sugar, protein, and starch, and will in the future furnish more and more of these raw materials to the factory where they will be fermented, distilled, and hydrolized into a variety of materials which will find a ready market in the usual channels of trade. As this method of utilization of farm products slowly develops so will the problem of the farm surplus slowly disappear and the farmers of America will become contented and prosperous as the workers in industrial lines now are.



NAVAL AEROLOGISTS WILL AID MILITARY AND CIVIL AVIATION

A close-up view of strato-cumulus clouds which indicate direction and speed of air currents. Aerologists are studying all that is known concerning the relation of clouds to the weather

Naval Aerologists

Weather Predictors, Naval By-products, Are Trained in Intensive New Course

By CAPTAIN W. D. PULESTON, U. S. N.

It is well known to SCIENTIFIC AMERICAN readers that the country receives many indirect benefits from the money spent on the navy in addition to the ever-present protection for which the navy is primarily organized and maintained. But probably only a few are aware of one of the latest naval enterprises which, when consummated, will confer a lasting benefit on the whole country.

Events of the World War demonstrated anew the profound influence weather has on the operations of war on land and sea. The increasing use of aircraft, both heavier and lighter than air, in our navy since the war, has made it increasingly desirable to obtain accurate forecasts of the weather. The United States Weather Bureau has for many years furnished forecasts for the land areas of the United States, and more recently has increased its service to include predictions for the shipping using United States ports, particularly reporting the development and progress of West Indian hurricanes. The Hydrographic Office has, since the middle of the last century, issued its pilot charts giving average weather conditions over all the oceans.

But neither of these splendid institutions could furnish the forecasts needed by the United States fleet which includes air, surface, and sub-surface craft, and which must be prepared to operate in any part of the world. Manifestly, therefore, the navy must have its own aerologists to accompany the fleet, and as there were scarcely any aerologists available for this duty in the United States, the Navy Department was compelled to commence training some for its own service.

Accordingly, in 1926, the Secretary of the Navy directed the Bureau of Navigation to select from the junior officers of the navy, eight volunteers of suitable qualifications to prepare themselves for this new scientific endeavor. From a large number of applicants, eight ensigns or junior lieutenants were chosen who had, while midshipmen at the Naval Academy, shown an unusual aptitude for mathematics, thermodynamics, and the physical sciences.

While the students were being selected, a board of officers began to prepare the course. This proved more difficult than selecting the students. No university or technical institute in the country offered exactly the course that was needed. One university offered an excellent course in meteorology, a professor in another university was the outstanding American authority on cloud forms, one of the world's foremost experts on oceanography was in our own Hydrographic Office, the most experienced of our practical American forecasters were in the Weather Bureau, a German was the acknowledged master of the dynamics of meteorology, the Smithsonian Institute possessed the leading authority on the effects of solar radiation on the weather, and in Sweden resided a scientist who had devoted his life to studying the effects of the polar regions on the world's weather.

It was necessary to familiarize our students with the works of all these authorities in order to furnish them a comprehensive course in aerology, and the board would have soon despaired of its task except for the enthusiastic support it received from all the many scientists interested in the study of weather.

Two universities and a technical institute offered to provide a specially designed course, separately or jointly; the Weather Bureau, the Smithsonian Institute, and the Hydrographic Office put their resources at the disposal of the board; every weather authority consulted, gave his time freely and abundantly to the board and offered to assist in a lecture course to the class. In a short time the board was able to concentrate on this new undertaking many of the scientific minds of America devoted to the study of weather.

The two-year course which commenced in 1926, was as follows:

FIRST YEAR:

(a) Academic Term: (Eight months) Regular postgraduate course at Naval Academy, emphasizing mathematics (differential and integral calculus, differential equations), aerodynamics, thermodynamics (textbooks by Buckingham and Birtwistle), meteorology (Milham), forecasting weather (Shaw), preliminary studies in physics of the air (Humphreys), and aerology (Aviation Training School Manual).

(b) Summer Term: (Three months) Instruction in weather maps—Bureau of Aeronautics, Forecasting practice—Bureau of Aeronautics and Weather Bureau, Oceanography—Hydrographic Office, Instruments—Naval Observatory and Weather Bureau.

SECOND YEAR:

(a) Academic Term: (Eight months) "Physics of the Air," Humphreys; "Dynamische Meteorologie," Exner; "Aeronautical Meteorology," Gregg; "Clouds," Clarke; "Cloud Studies," Clayden; Survey of the works of Bjerknes (Bergen Geophysical Institute); in addition, daily practice in map drawing and forecasting.

(b) Summer Term: (Three months) Study of naval aerological problems and aerological practice at naval air stations, Lakehurst or Pensacola, including forecasting practice.

The first class of eight officers completed this course last fall and have already been detailed to various vessels of the fleet to commence forecasting the weather. It is inevitable that these pioneer predictors will make some mistakes in their forecasts, and they will often be bantered by waggish messmates, and occasionally upbraided by an indignant Admiral misled by an erroneous forecast, but it is also safe to predict that these scientifically trained minds, resolutely undertaking a problem unsolved at present, will at least stumble forward and eventually either they or their successors will completely unravel the complicated laws of weather, and develop a system that will provide an accurate forecast of the weather.

THE second class began its second year's work at the Massachusetts Institute of Technology last fall, where a special course modeled after the one previously described, was arranged for them through the keen interest of the president of that institution. The Guggenheim Foundation immediately recognized the value of the course to the future of aviation, and has endowed a chair at the Institute of Technology, thus making the course available to civilian students. The army was quick to realize the advantages of the course, and is also sending students to the class.

Thus in order to satisfy the needs of the navy, a course of study in weather forecasting has been established that will undoubtedly be beneficial to the country at large. It may be added that it was undertaken none too soon for our country's credit. In England, Germany, and Sweden, such courses are already available and consequently they have gained on us in knowledge of weather.

Enough is already known of weather prediction to realize that more numerous and complete reports on conditions affecting the weather are required before much further progress can be made. For instance, comparatively few reports are obtained of conditions over the Pacific Ocean, yet the weather on our west coast is immediately affected by these comparatively unknown conditions. Nor is it sufficient to know the conditions at the surface of the earth. The upper air strata must be explored. Fortunately the Navy Department is able to assist in obtaining data over the ocean by its own vessels, and by observers on merchant ships, who since the middle of the last century, have assisted the Hydrographic Office and the Weather Bureau to collect the data on which its current and pilot charts are based.

SAN DIEGO CLOUDS

Typical May day strato-cumulus clouds over the California city, near the coast

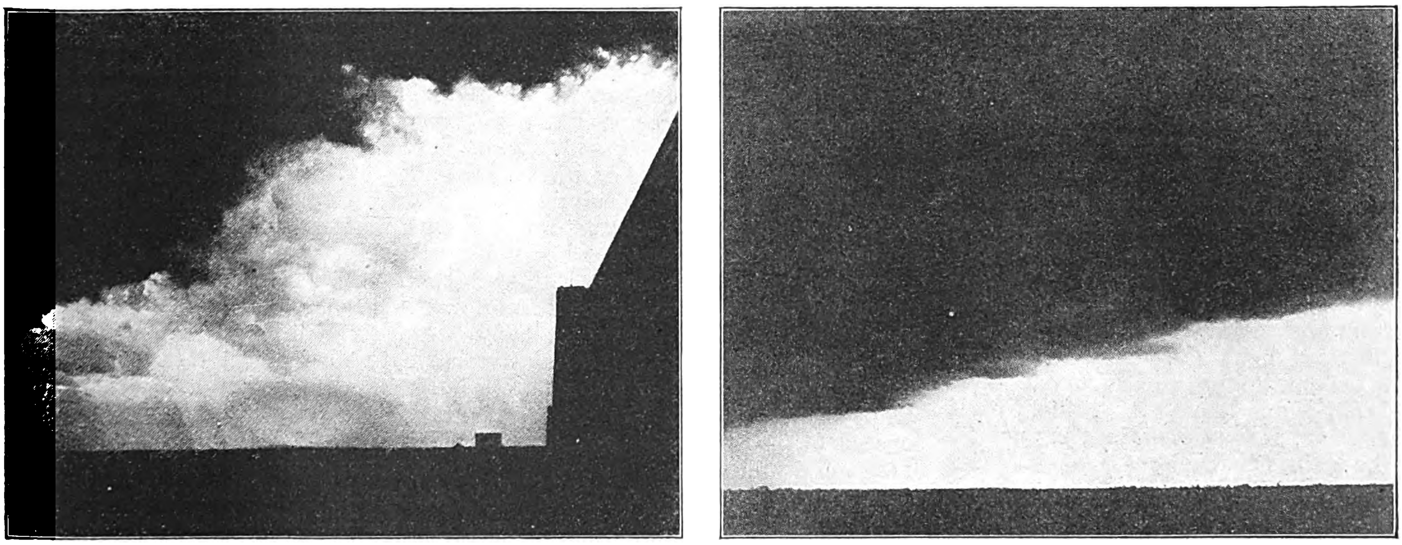
These marine observers, once they are trained and supplied with the necessary instruments, will be able to supply additional data to predict the weather actually brewing while it is in the making. The Hydrographic Office has already begun to enroll its marine observers in the new undertaking. The various air stations of the government, and many of the existing Weather Bureau stations are prepared to take air soundings to obtain data on the condition of the upper air currents.

It is planned first to equip men-of-war so they can obtain data of upper air currents, and then gradually to equip especially selected merchant vessels so that American predictors can anticipate, in the near future, receiving greatly increased data upon which to base their forecasts. Practically all merchant vessels are now equipped with radio, and certain naval radio stations have already assigned special schedules to receive and broadcast reports from observers in waters surrounding our country, so there will be small delay in collecting and disseminating weather data.

RADIO not only furnishes the means of forwarding weather data, but radio static has already been used as an auxiliary means to locate and follow a "disturbance," or area of low barometric pressure as an embryonic cyclone or hurricane is called before it matures. Radio static has not been observed to accompany all disturbances, so it is not an infallible indication of a storm.

The ideal information system which the Navy Department and Weather Bureau have in view will eventually provide a continuous flow of information of the conditions at the surface and in the upper air strata over the land and water regions adjacent to our own coasts, in addition to the information of conditions in the interior of our country.

With this comprehensive information continually received, our carefully trained predictors will immediately be able to increase greatly the accuracy of weather predictions, gradually add to our knowledge of weather, and eventually reveal completely one of nature's last and most carefully guarded secrets, the laws of weather.



CLOUD FORMS FURNISH IMPORTANT CLUES TO WEATHER PREDICTORS

Excellent examples of strato-cumulus clouds changing to cumulo-nimbus, taken at the Lakehurst Naval Air Station. The one at the left shows the ragged edges of the clouds and the characteristic turbulence. Airship shed in foreground. At the right; a different view

The New Outlook In Physics*

"We Have, Indeed, Far to Go: We Have as Yet But Scratched the Surface of Things"

By SIR OLIVER LODGE

IN a recent address on "Literary Biography," Mr. Philip Guedalla has wittily said that "Biography is a thing with perfectly definite limits; it is a region that is bounded on the north by history, on the south by fiction, on the east by obituary notices, and on the west by tedium." We may parody this by saying that the science of physics is bounded on the north by mathematics, on the south by experiment, on the west by accumulated experience of the past, and on the east by intuition and speculation.

The northern region is cold and arid, but exceedingly bracing and stimulating to those who have sufficient clothing to enable them to feel at home in those icy fastnesses, whence descend fertilizing streams to the plains below. The southern region is more habitable, and very fertile in all manner of practical contrivances which have modified, complicated, and to some extent ameliorated, the lot of mankind: so that it leads into a region of tropical fruitfulness in which the engineer and the capitalist are more at home than the pure physicist. The western boundary is one towards which our luminaries appear to be continually descending into comparative oblivion, leaving behind their fructifying influence, and becoming themselves more or less superseded and out of date.

It is to the eastern horizon now that all eyes are turned, watching the luminaries that are ascending through the mists of the morning, only dimly seen as yet, but bringing with them a great promise for the future and hopes of a clearer sky when the clouds have cleared away.

THE electron was one of the objects on which our scientific observer feasted his eyes, at the beginning of this century, as a definite speck of brightness. But now it is drawing itself out, and seems more like a comet than a fixed star. Its boundaries have become blurred, and its locality indefinite. From one point of view the definite points of light seem merging into a sort of continuum; while, from another, a continuous luminosity gathers itself together into discontinuous points. The gain of definiteness on the one hand is mingled with a loss of definiteness on the other. A continuum seems breaking up into discontinuities, and yet discontinuities show signs of merging into a continuum. It is impossible to say what the outcome will be, and it would be rash to make the attempt. Suffice it to say that a greater unity is beginning to be discerned throughout the material cosmos; and that the initial stages of some comprehensive unification are of great interest for the present and of good hope for the future.

Let us now trace these unifying resemblances rather more in detail.

The atom has yielded up some of its secrets; and so have the stars. The two things, so different in scale, are more alike than had been expected, and investigation of the one helps our knowledge of the other. It is probably true that more is known about the interior of a star than about the interior of the earth. Some of the stars are disintegrating into radiation, and so are some of the atoms. Nothing material is permanent, everything is in a state of flux; as indeed was said long ago by Heracleitus as a brilliant intuition. But it is turning out more literally true than could have been anticipated. Old-established laws are modified and half discarded, new laws take their place, and we are surrounded by uncertainty. The conservation of matter has had to be discarded, and there are signs that even the conservation of energy begins incredibly to be suspect.

MEANWHILE, matter and energy have merged into one another; both are treated geometrically as if they were properties of space, or rather of the greater generalization called space-time; and there is beginning a great unification which, in spite of present complexity, seems likely to lead to an ultimate simplification. Electricity and magnetism, whatever they may be ultimately resolved into, seem likely for the present to reign supreme. Already they have dominated and annexed the domain of optics and light; they are depended on for cohesion; and now they seem likely to absorb gravitation likewise. Matter already is largely electrical, some think wholly electrical. It has been discovered to be one of the forms which energy may take.

The whole of activity consists in the transmutation of forms of energy; although what energy is in itself remains an open question. Space is discovered to have physical properties: and just as Faraday recalled our attention from the conductors supporting electric charge to the space surrounding them, and showed that all the observed phenomena really went on in that apparently empty space, so it would appear to be with our wider outlook in the near future. Matter is turning out to be an insignificant portion of the whole physical universe, a rare and occasional perturbation of its vast extent; and probably the more important, although certainly the more elusive, activities occur in the inter-atomic, inter-planetary, and inter-stellar space.

HITHERTO our attention has been concentrated and almost entirely limited by our senses to the particles and aggregates of matter. But now our minds are ascending beyond the scope of sensation into the fundamental region in which matter exists. All the heavenly bodies move in a vacuum; and so does every atom. It is in the interspace that the energy really lies. Something in space it is which welds particles together by cohesion into a tangible body, and welds bodies together by gravitation into a cosmos; so that the properties of that interstitial space are likely to form the greater part of the physics of the future.

We know something about empty space already; we know that it can transmit radiation, and we know the rate at which radiation travels. There seems no doubt about that, although the intimate or ultimate nature of radiation we do not yet know. We realize that it is a modification of space, and we can follow the modification in time. But what unmodified space is like, and what time is like, we do not know. We can, however, experiment on radiation by aid of its interaction with matter.

Another modification of vacuous space we call an electric charge, and we can make experiments on that too. Surprisingly it has inertia, and is amenable to mechanical force. It almost certainly has weight. Another variety of obscure energy we call a magnetic field. These are all modifications of space; and probably the very ingredients of the atom of matter are modifications too, for the atom is composed of positive and negative electric charges, far apart from each other in proportion to their size. Herein enters the possi-

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*Written by special arrangement with the respective Editors, for simultaneous publication in the SCIENTIFIC AMERICAN and *Discovery* (London).

bility of experiment. We can apprehend and deal with matter; for it is an immediate inference from our tactile sensations, and we are provided with muscles which enable us to move it—to move it in accordance with plan. We might define matter as that which can be moved; although what "motion" really means we should find it difficult to explain. Matter and motion are things we have senses for, so that we have grown accustomed to them, and are apt to forget their mysterious nature. The problem of modern physics is to try to understand these over-familiar things and to resolve them into something more ultimate, although at the moment less intelligible. Not unnaturally our early attempts at formulation involve unfamiliar and even contradictory modes of expression.

Whenever we encounter or seem to encounter an insoluble discrepancy between reality and reason, or rather between what we apprehend as reality and our particular brand of reasoning, we may assume that not the Universe but either our apprehension or our reasoning is at fault. It is an act of faith so to assume; but it is a faith that has been justified in particular instances time and again. The uniformity of nature, the sequence of cause and effect, rests on no surer foundation. Such faith is essential to the pursuit of science; and I presume that faith of that kind is acceptable to theologians. In that faith we shall be wise if we continue, whatever else we may feel constrained to discard. If we could solve all our difficulties while we tramp along, existence would be duller and less stimulating than it is.

Other things interact with matter besides light and gravitation, and thus also have come within our sensory ken. "Life" interacts with matter; so that we are accustomed to observe living things, both animal and vegetable. But what life really is, and how it interacts with matter, we do not know. A department called bio-physics is growing up, which seeks to investigate the interaction of life and matter. Perhaps life is a modification of space too?

ANIMATED matter obeys the laws of physics and chemistry just as ordinary matter does: yes, we may grant that to be true; but yet, when animated, it has something superadded. It has properties not possessed by the inanimate—a kind of spontaneity, a sort of self-determination. Or at the least it is formed into a characteristic shape not dependent on the kind of food supplied. And when in its higher stages life blossoms into consciousness—our own consciousness—we have first-hand knowledge that it is able to form strange conceptions; that it has not only memory of the past, but anticipation of the future also; and that it can determine to act accordingly. No mechanism can do that, so we are more than mechanism. We can form plans and carry them out. We can brood and meditate and partly understand. Occasionally we can even predict. We are guided by the future as well as by the past.

If, indeed, life is a manifestation of one of the properties of space-time, it is one of extraordinary interest, for it suggests scope for investigation far beyond anything previously contemplated by science. Mind—whatever it be—leads us into a region of the infinite and the incomprehensible. It seeks to understand. And where it fails to understand it can admire. It can admire the beauty of structure and processes; it can marvel at the adaptation and splendor of nature, the interlocked intricacies of its laws. And when these too pass beyond its scope, so that they are no longer apprehensible, but merge into the unfamiliar and the eternal, it is overwhelmed by a feeling of awe, and takes refuge in the human faculty of worship.

JUST as science believed it had the ultimate secrets of matter learned, they vanished in its hands. This is an age of marked change, a fitting time to take an inventory. Hence the present article.
—*The Editor.*

A SOMEWHAT modified view of mechanism still holds the field; but it is mechanism of a glorified kind. No longer do we expect to explain all even purely physical realities in terms of matter. The old mechanical models of ether will not work. Now that we realize what a comparatively exceptional peculiarity matter is, and how dependent it is on the properties of the medium in which it exists and out of which it is presumably formed, it is in no way surprising that the aim now is rather to explain the behaviour of matter in terms of a more fundamental reality, than to seek to model reality under the guise of a material assemblage. Even the physical universe is far greater than the limited material aspect which appeals to the senses. The true nature of physical phenomena is to be sought in space and its properties. The attempt to find a mechanical ether, and to define it in terms of material machinery, has been perforce given up. Yet the name "ether" may survive, for there is certainly a physical reality filling space. Can it be a substance? It is sub-stantial in that it stands under everything—a truly fundamental substance, although unlike any substance with which we are acquainted.

Herein lies the immediate problem of the future. This may be regarded as the next extensive step or aim in physics—to weld together the newer and the older discoveries into an all-embracing system which shall include them all—although probably it may do so in ways which at present we can barely guess. To make revolutionary progress we must transcend matter and its relative motions, and must formulate the properties of the fundamental entity which fills space and endures in time. There must be something in it of a periodic character which justifies our sense of duration, and accounts for all the properties of matter. The mind is stretched to the utmost, but we do not despair. Rational the universe has always been, and rational it assuredly is. In other words, it is in harmony with the human mind, when that is sufficiently informed and enlightened to perceive the grandeur of truth.

EXPERIENCE has consistently shown that there is a rational process behind everything, and it is possible for us by patient investigation to ascertain the working of the process and to study the laws of its operation. Theologians would surely admit that nothing is accomplished save by rational methods; nor is there any intervention by other than accredited agencies or agents—however transcendent some of them may be. As was said of old about the Logos—the Personification of Reason, of Law and Order—"Without him was not anything made that was made."

It is the privilege of science to contemplate creation and to work it out; to realize what is happening and to dive down as far as we can to the innermost core of the mystery. We have, indeed, far to go: we have as yet but scratched the surface of things. Only lately have we begun to probe the constitution of the atom; only recently have the stars and nebulae begun to display their heriditary connection. The birth and death of worlds is now being contemplated by science. We are witnessing something of the process of creation actually going on.

Humanity is in its infancy. What wonder if we stumble and halt by the way. Yet we are making progress. We that were walking in darkness have caught a glimpse of a great light. Naturally we are dazzled, and it may be perturbed. But we live in a privileged age. Men of genius as great as any in the past are working among us. Some great generalization is approaching; and mathematical physicists all over the world are contributing to its arrival. The work may have to go on for a century before the sun rises, but through the haze and mists of the twilight we catch a glimpse of a rosy and hopeful dawn.

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.

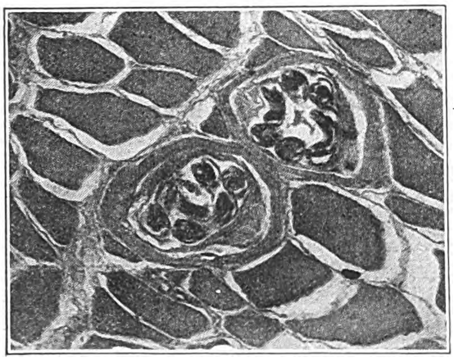
Editor of the Journal of the American Medical Association *and of* Hygeia

Golf Balls and Lead Poisoning

GOLF balls have been blamed for all sorts of peculiar symptoms and troubles, but it is extremely unusual to find that it is possible for some one to get lead poisoning from contact with the elusive pellets. In a case described by Dr. H. W. Wuerthele, a boy 16 years of age was concerned. He was a caddy. One evening he was suddenly taken with the cramps that are typical of lead poisoning and was found on examination by the physician to have some of the other symptoms associated with lead poisoning. Close questioning revealed that the boy had been cutting open golf balls and rubbing the lead contained in the little rubber sack found within the ball on some old balls that he had found about the links, and which he was preparing for sale to some golf players for use as practice balls. He had probably eaten his lunch without washing his hands and a good deal of lead had entered his system in this manner, producing lead poisoning.

An Epidemic of Trichina

AS long ago as 1821, a German discovered that people could become seriously ill following the eating of infected raw pork and that there were little foreign substances in the muscles in this condition. Not long ago forty-three people in Albany and in communities near Albany, New York, were involved in an epidemic of trichinosis following the eating of insufficiently cooked or uncooked pork sausage. It appears that two residents of Albany had gone to a neighboring town for a visit and while there had purchased from a butcher a pig which they brought back to Albany. From the pork, they made sausage with garlic and peppers, and some blood sausage, keeping some of the meat that remained for use as bacon and salt pork.



TRICHINA

A section of pork that caused an epidemic, showing the encysted *Trichinella spiralis*

They operated their home as a boarding house, mostly for Spaniards, and most of the people who were sick had eaten of this pork at the boarding house. When the pork was examined, it was found to contain the organism known as *Trichinella spiralis* and a similar organism was found in tissue removed from thirteen of the persons affected. Practically all of those people suffered with muscle and joint pains, swelling of the face, and general fatigue. Many of them had severe headache and vomited.

Several epidemics of trichina occur regularly each year in the United States due to eating pork that has been infected and which has not been sufficiently cooked.

Treatment of Burns by Skin Grafts

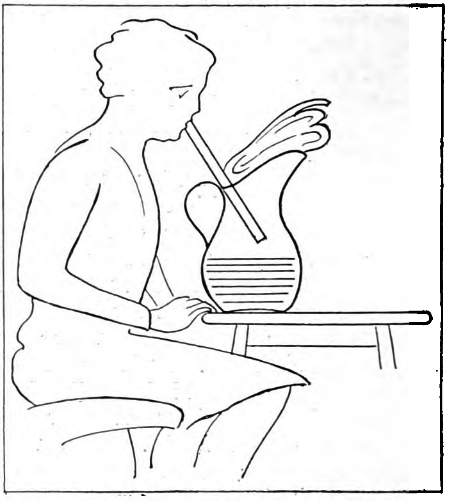
ONE of the unpleasant features of severe burn of the skin is the fact that the skin tends to contract and produce much distortion of the tissue. In order to overcome this condition, modern surgeons remove the skin tissue and substitute for it skin grafts taken from other portions of the body.

Considerable ingenuity has been developed in finding the best place for the transfer of the tissue and in actually moving large sections of skin from one portion of the body to another. In the transfer, the hand or arm which supplies the skin is held in such a position that the extra piece of tissue maintains contact with its original position and blood supply until it has grown into its new place, after which it is severed from the original point and permitted to remain permanently at the new point.

Inhaling Steam

NOT infrequently doctors advise the inhalation of steam for the relief of irritations and swelling in the throat. Various methods have been recommended for this purpose, including the filling of a bowl with hot water and steaming of the entire face and head which are covered with a towel, and the use of a cone of paper or cloth put in the tea kettle or some other vessel of boiling water. In this way the face, nose, and ears, as well as the throat, are steamed.

A physician in the Massachusetts General Hospital has developed a system for this purpose which avoids steaming of the face and nose and permits the application of the steam directly to the throat. The equipment is any metal receptacle containing two quarts or more of boiling water; a tube about a foot long, preferably of rubber; and a towel. As shown in the illustration, one end of the tube goes in the patient's mouth and the other is held about an inch above the surface of the water. The patient then breathes through the mouth, taking rather deep breaths, while the opening of the vessel is closed with the towel. In the use of such a device, care must be taken to have the pitcher or vessel of hot water fixed in such a way that it will not fall over and spill on the patient. The tube may well be clipped to the top of the vessel in such a manner that it will not drop down into the water which would allow the patient to suck the boiling water into the mouth.



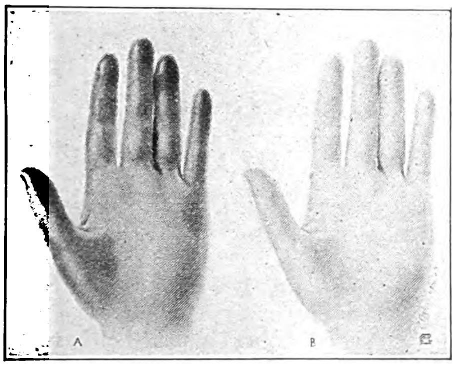
INHALING STEAM

A towel covers the mouth of a vessel of boiling water, from which steam is to be inhaled for the treatment of throat irritations

Raynaud's Disease and Its Surgical Treatment

RAYNAUD'S disease is one of the most peculiar conditions known to scientific medicine. In this condition the extremities, either the arms or the legs, become blue and indeed proceed to gangrene. There are neuralgic pains, diminished sensibilities of the skin, and a general sensation of coldness. This disease occurs most often in women between 18 and 40 years of age, although cases are frequently seen in men.

A distinction has to be made between this disease and a similar condition known as Buerger's disease, or *thrombo-angiitis obliterans*, in which the blood vessels primarily are involved. In many instances in Raynaud's disease there seems to be some relation to a severe psychic disturbance, although associated with this there have been crushing accidents of one type or another.



RAYNAUD'S DISEASE

Left hand: A, before nerves were cut. B, following sympathetic nerve root removal

The condition has heretofore seldom yielded to ordinary methods of treatment. Some years ago it was suggested that the nerves of the sympathetic nervous system, which control the contraction and relaxation of the blood vessels, might be cut apart and in this way permit free circulation of the blood to the extremities affected by Raynaud's disease. Recently an operation was performed on a patient with this condition in which the nerve roots concerned were removed. In the hand on the side on which the nerve roots were removed, the temperature was increased and the circulation was improved. The benefit was so great following the operation on the one side that the patient asked voluntarily for an operation on the other side with a similar good result. More than three months after the operation the results were still maintained. The procedure is one of the most difficult known to modern surgery, but the results are so striking as to cause the investigators to believe that the surgical control of this disease is an accomplished fact.

Leprosy

THE present population of the National Leprosarium in Carville, Louisiana, is 285 lepers. This does not constitute by any means all of the lepers in the United States, since the evidence indicates that there are many cases not recognized. The disease does not actually constitute a general menace, since infection is only by direct contact. Leprosy is an exceedingly chronic disease, lasting on the average for 14 years from the first appearance of the symptoms.

During a period of 34 years, 718 lepers have been hospitalized in the leper home in Carville, which formerly was a state institution. Of the lepers, 215 were born outside of the United States and 503 in this country. Mexico, China, Italy, and the Philippine Islands furnished one half of the foreign born lepers. Seventy-two and three tenths percent of the patients are male and only 27.7 percent female.

The disease afflicts apparently all classes of the population, the average age at onset being 30 years and the average age of admission to the hospital 36 years, so that in practically every case the persons were free in the community for six years before their condition was correctly diagnosed and arrangements made for hospitalization.

During the last seven and a half years, 28 lepers have been paroled from the Leprosarium and of these only one has had a relapse which made it necessary for him to be taken back into the institution.

Chlorine in Water Purification

THE first practical apparatus for chlorination of water was made in 1913. In 1926, 3200 American communities were using four billion gallons of chlorinated water every day, and the evidence indicates that 70 percent of the population of the United States depends on chlorinated drinking water for its supply. Furthermore, the method has been adopted for swimming pool disinfection, disinfection of water mains, and the treatment of water used by travelers.

When chlorination was first introduced, all sorts of superstitions developed as to possible dangers, including the belief that it would cause sterility, cancer, or Bright's disease, and decrease the birth rate. It is no longer necessary to contradict such notions, although in time of epidemic they are likely to develop again.

Chlorinating apparatus is manufactured today in the United States, England, Germany, and Spain. In some countries of South America installations have been made so rapidly that practically the entire drinking water supply is chlorinated. In many places water is filtered first and then chlorinated; in other places, chlorinated before filtration and after, and in some places, where considerable doubt exists as to the quality of the water from the point of view of infection, repeated chlorination is practiced.

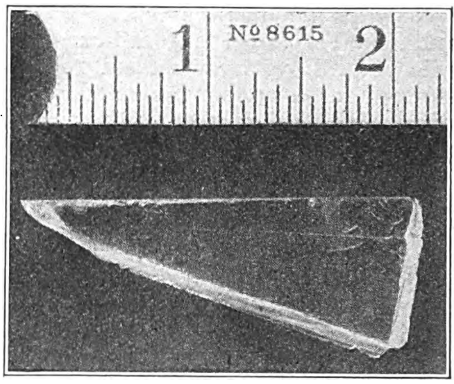
For swimming pools, the Joint Committee on Bathing Places of the American Public Health Association and the Conference of Sanitary Engineers has decided on chlorination as the method to be used. Next to treatment with chlorine as a gas or watery solution, continuous application of a solution of sodium hypochlorite is recommended. The amount of available or excess chlorine in the water at all times when the pool is in use should be not less than 0.1 part per million and not more than 0.5 part per million.

For travelers, chlorine disinfection is practiced by the use of tablets of compound chlorine; the substance most often recommended is Halazone. If the water is turbid, it is preferably filtered first and then chlorinated in order to purify it.

Glass in the Glottis

ON December 11, 1927, a man was thrown through a windshield in an automobile accident. When he was picked up, the left side of his neck was found to be lacerated and he was unconscious due to concussion of the brain. He was taken to a hospital and there a piece of plate glass one and one half inches long and one half an inch wide was removed from the wound in his neck and the wound closed. Three weeks later he was well and returned to his work as an installer of furnaces. For several months thereafter, however, he continued to complain that he had difficulty in talking and he constantly had a great deal of mucus and purulent matter discharging from his throat. He complained also of trouble in swallowing.

Finally, after four months had passed, he went into a hospital for treatment and it was planned to remove his tonsils. Investigation showed an abscess in the lower side of one tonsil. When an attempt was made to wipe away the secretion from this abscess, a hard mass was found. The operator grasped this mass with his forceps and after some manipulation was able to remove it. It was found to be a triangular piece of plate glass measuring two and one-quarter inches by one inch. This glass had remained in the glottis for 116 days, causing all this time irritation, swelling, and general disturbance.



GLASS

This piece of glass was removed from a man's glottis. Note in particular the sharp edges

The Vanishing American Indian Medicine-Man

With the Passing of the Tribal Wise Men, the Secrets of the Remedies Used by These Primitive Practitioners Are Being Lost to the World

By DONALD A. CADZOW
Museum of the American Indian, Heye Foundation

KEEVISK, MEDICINE MAN

Some of his exploits are described in the author's article. Secrets will die with him

THE steady throb of a tom-tom sounded over the Moapa desert in southern Nevada. Occasionally the shrill voice of an Indian chanting could be heard coming from the grass covered *wickiup* near the bank of a sluggish, muddy stream. It was Grasshopper, a Piute Indian medicine-man, working over a sick woman. For three days the old fellow had been doctoring his patient, without apparent effect. All the herb mixtures and magic formulas that Grasshopper knew had failed to rally the sick squaw, and the old Indian was in despair. His voice grew harsh as the night wore on, and the beat of the tom-tom grew wilder until, with a muffled roll, it stopped for a moment, started again with a soft echoing throb, remained mute.

Grasshopper had failed.

THE next morning the desert sun, creeping over the horizon like a golden ball, revealed an odd sight. In front of the *wickiup* in which the doctoring had taken place, lay the body of a man. It was Grasshopper, strangled to death according to the unwritten laws of his people. For if three patients succumb to disease among this group of American Indians, the doctor is put to death; and he is sometimes killed for refusing to treat an ailing person when asked to do so by relatives. Medicine-men who were not successful in effecting cures among the Piutes did not live long.

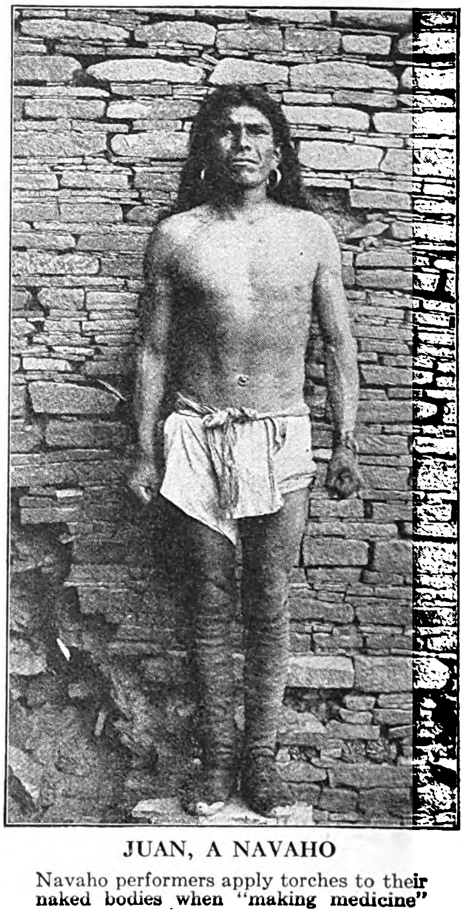
Some fake doctors, probably through "magic" and "thought cures," prospered for a time among the American Indians, but the real medicine-man, as known to the average tribe, was the one who treated his patients by the use of herbs, barks, and roots of certain trees and shrubs, the knowledge concerning the use of which has been handed down through the ages. Many of the most potent remedies have been lost to mankind within the past generation, for many an old medicine-man has taken his secrets with him to the grave, rather than have them used by someone who did not have a sincere belief in the old Indian ways.

In mixing concoctions for various ailments, a medicine-man will sometimes use many different herbs, roots, and barks, and then, again, a single species of plant is used. Trips involving, in some cases, hundreds of miles are made to obtain plants that do not grow in the section in which the "doctor" lives. Many botanists have been amazed at the uncanny knowledge some Indians have regarding the flora of regions at great distances from their homes.

KEEVISK, a Cree Indian, who makes his home on the File Hills reservation in the Province of Saskatchewan, Canada, is one of the last of the great medicine-men left in the West. He is very old and partially blind from trachoma, a disease brought to his people by the white man. But regardless of his affliction, he still practices his ancient art passed down to him from his father, and he cures his patients of many ailments. He can see only dimly the objects he uses, but his senses of taste, smell, and feeling are supernormal. And, unerringly, he selects medicines from his store.

I had heard of this great healer, Keevisk, from the Bungi Indians who live hundreds of miles to the east of his home. They told of the remarkable things this man has accomplished, and I was particularly anxious to see and talk to the old fellow. He was sitting crossed-legged on an old cow-skin as my interpreter and I entered his tent. After the customary salutations and exchange of tobacco, the old man, speaking through the interpreter, asked if I wanted something to cure my sore throat. I had one all right, as I knew only too well, but how Keevisk knew it is more than I can fathom. He gave me a piece of root to chew and in a few minutes my throat felt better, and that night the soreness disappeared entirely.

While I was visiting with Keevisk the following day, a white man came to his tent and asked the old fellow for his medicine. According to this man's story, he was a rancher and an ex-Canadian soldier, who had contracted a skin disease in France during the war. Several army doctors had worked on him without any apparent results.



JUAN, A NAVAHO

Navaho performers apply torches to their naked bodies when "making medicine"

Engineering Library

Keevisk had been giving him medicine for three months and his skin was almost clear.

In the interest of science I tried to gather some of Keevisk's formulas, but the old man was very reticent about passing them on. Most of them will die with him, as he has no son with whom he will trust his secrets.

The Seminole Indians of the Florida Everglades, the Creeks, the Choctaws, and other tribes who live in the southeastern part of the United States, had a great number of medicine-men. Some of these men were herb doctors, but most of them were magicians who were supposed to have the power to dispel disease by chanting certain secret formulas. In many ways their cures were effected by making the patient believe that he was recovering, and very often he did. Illness within these tribes was generally believed to have been caused by an animal that had the disease and passed it on to a human being. Carrying a fetish made from some part of this animal was supposed to be a great help for a sick person. Because of this belief, a good medicine-man always had fetishes or charms, created out of various parts of the animals of the region. These were always sold to patients at a very good profit.

AMONG the Navahos and Pueblos, who live in the southwestern deserts, medicine-men and medicine-women still thrive. The Pueblos have specialists for various forms of disease, and have had them for centuries. Among these people we also find some of the original rubbing doctors or chiropractors, who work their cures by massaging the spine and other parts of the body.

Pocia, a Zuñi Pueblo Indian, still practices his ancient art of rubbing away sickness, in the village of Ojo Caliente, not far from St. Johns, Arizona. A few years ago an expedition which I was with, was digging into an ancient ruin in this region, when the stone walls of one of the rooms fell upon an Indian workman, named Waiku. He was carried into our camp badly bruised and apparently a very sick man. Upon his request, I went post-haste for three medicine-men. Among them was Pocia. When I arrived with the delegation of doctors, Waiku was lying upon a cot, and, if appearances meant anything, he was well on his way to join his fathers.

MEDICINE WOMAN

As with the white race, so with the Indian, there are "medicine women"

It did not take Pocia long to get into action. Waiku was stripped of his scanty clothing and every bone in his rangy body was carefully felt by Pocia. His spine was massaged, and upon being informed by a man in whom he had absolute faith, that everything was all right, he took a new lease on life. A healing lotion for bruises was rubbed on Waiku's body by another medicine-man and he sat up on the side of the cot. The third medicine-man chanted a few magic songs to drive away the evil spirits that had caused the wall to fall, and in a short time Waiku walked home to his family.

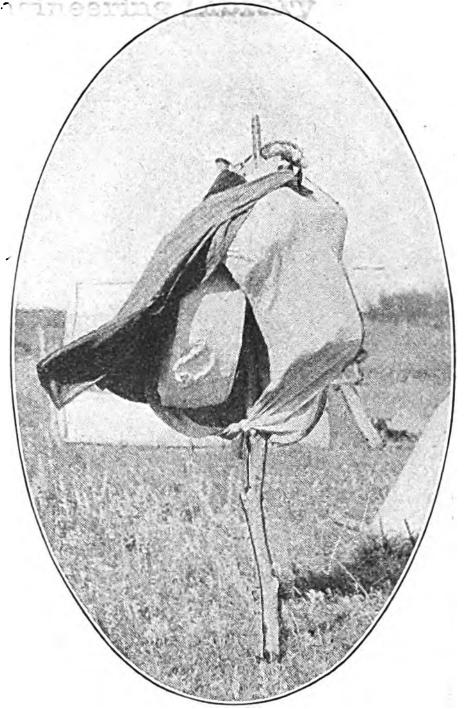
Very often animal and mineral substances are used by medicine-men among the southwest Indians. The bite of a snake is treated by applying to the wound a portion of the ventral surface of the body of the same snake.

THE Papego doctors sometimes made their patients eat crickets as medicine; the Tarahumare doctors, lizards; and the Apache had great faith in the use of spider eggs.

The Hopi Indians blow fire on an inflamed surface to counteract the supposed fire within the body which causes the ailment. The medicine-men of this tribe are also believed to have a positive cure for the bite of a rattlesnake. Many men have tried to find out what this cure is, but without results. Thousands of white people have seen them handle rattlesnakes in their famous snake dance without ill after-effect.

The most accomplished of the medicine-men among the Indian tribes south of the United States-Mexican line practiced a primitive surgery, by external manipulation, and otherwise. Probably the highest surgical achievement practiced, in part, at least, as a curative method, was trephining, or taking a small disk from the top of the skull. Why this was done no one seems to know. But the practice is very ancient, as the skulls of many of the Indians of Peru, upon being excavated by archeologists, are found to have been trephined.

Dental surgery was also practiced in ancient times by the people of some parts of Central and South America. Occasionally, skulls have been found by explorers with the enamel of the front teeth very skillfully scraped off and round solid gold disks inset. Teeth are still extracted by very painful methods among many of the tribes.



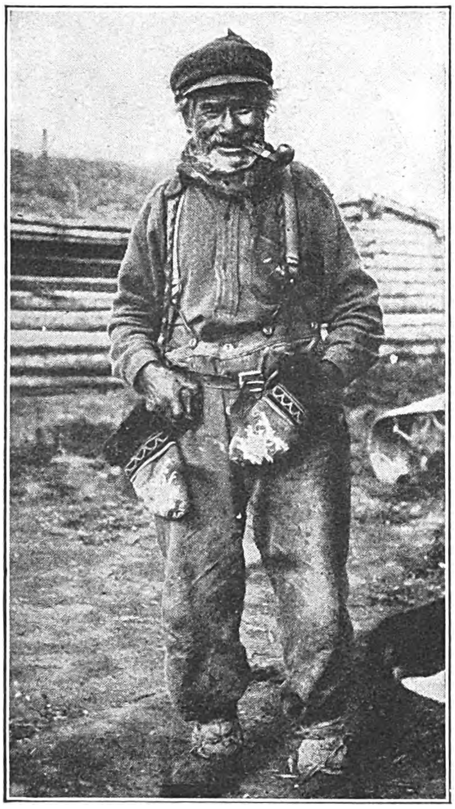
MEDICINE BUNDLES

Tied to a stick behind the tent of a medicine doctor. They contain magic objects

Scarifying, or bleeding, at the seat of pain was common among most Indians. In some places this was done with a cupping horn which was placed over a small incision and the blood sucked out by a medicine-man. I have seen the chests and arms of an Eskimo a solid mass of scars from blood-letting.

The cause and the nature of disease being, to the Indian, in a large part mysterious, he often assigned them to supernatural agencies. In general, every illness that could not be attributed to a visible influence was regarded as an effect brought about by malevolent or offended supernatural beings, or through sorcery or magic practiced by an enemy. These beliefs were general and directly the cause of the practice of these arts.

MAGICIANS and sorcerers were, as a general rule, very different from the herb doctor or real medicine-man. Many of the old explorers in the New World marveled at the powers of the Indian magicians, and in their writings attributed this power to Satan. Father Acosta, in the 16th Century, spoke in awe of the Mexican magicians flying through the air and assuming any form they desired. The Reverend Peter Jones wrote in the early part of the 19th Century: "I have sometimes been inclined to think that, if witchcraft still exists in the world, it is to be found among the aborigines of America." His experience was among the Chippewas who had their homes around



QUALALATI

A cheerful example of the effect of the white man on the Loucheux Indians of Alaska

the north shores of the Great Lakes.

Some of the feats of Indian magicians are easily explained as sleight-of-hand tricks. Their deceptions are very often ingenious, when one stops to consider how crude are their tools and appliances. Many of their conjuring tricks have never been explained, however, and many of them have passed on with their masters.

When I was in the arctic regions I met an Eskimo magician called Pokiak. After convincing him that I had great faith in his so-called powers, I was allowed to "sit in" at one of his seances, together with several Eskimos. The dim light from the flickering stone lamp flashing against the snow walls seemed to cast a supernatural glow and I allowed myself to relax and fall under his spell. First, two huge and ugly teeth seemed to grow from his mouth and protrude almost to his chin. In an instant this apparition faded and a tame martin, or American sable, walked over my shoulders and lap. It sprang from my lap into the arms of Pokiak and then disappeared.

NEXT, we were taken on an imaginary trip to the Moon. We were all told to kneel with our noses pressed to the ground. The magician commenced to chant and sing in Eskimo, all the while whirling something over our heads. In the interest of science, I "peeked" and was rewarded with a bang on the head; and then I saw stars and planets in great numbers skimming past. That incident broke up the seance, but I later learned that Pokiak stood in the center of our little group whirling over our heads a rock attached to a cord, and the Eskimos knew what to expect if they "peeked." But, of course, I did not.

Many white men who have lived with or near the American Indians have tried to discover how their "moccasin telegraph" works. In reality this appears to be a telepathic knowledge of events occurring in distant places, in some cases hundreds of miles away. My own experience with this telegraph was in the MacDougal Pass, in the northern part of the Rockies. It was my intention to cross over from the Mackenzie to the Yukon via this Pass. No one, to my positive knowledge, went through that Pass ahead of me that season. Yet the Indians on the Yukon side were ready and waiting with collections of specimens for me when I arrived on their side of the mountains.

A stunt among many tribes of the far north was to bind a magician hand and foot, and then, without visible aid or effort on his part, he would release himself from the bonds. Civilized conjurers who perform a similar trick are usually hidden in a cabinet and claim supernatural assistance. Most of the Indians do this feat under observation. A very common trick among Indian charlatans was to pretend to suck foreign bodies, such as stones, out of the persons of their patients. Records of this are found among many tribes from those lowest in culture to the highest in the scale of progress.

NAVAJO performers, naked except for breechcloth and moccasins, and having their bodies daubed with white clay, run at high speed around a fire holding in their hands torches made of cedar-bark, which they apply to the bare backs of those running ahead of them, and to their own person, yet they never seem to be injured by the flame.

I have seen a naked Indian magician place a wooden sword, about 14 inches long, in his mouth and force it down into his throat until only the feather decorations on the end protruded. Then, to prove he was not faking, he placed another stick in his mouth and forced that into his throat beside the first. I examined and purchased the sticks with which this stunt was performed and convinced myself that they did not collapse when placed in his mouth.

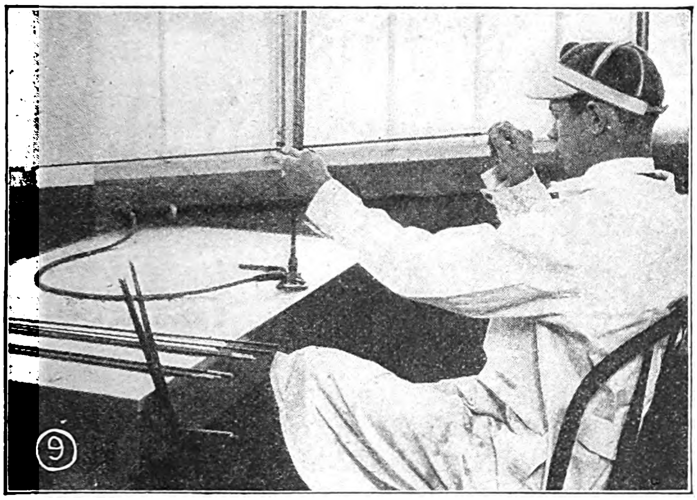
I have met a number of white men in the west who have a great deal of faith in Indian medicine. But probably the most interesting and sincere of these was an old "desert rat" down in the Moapa section of Nevada. The Piutes called the old fellow "Red Wolf." At some time in the past an Indian medicine-man had cured Red Wolf of a variety of ailments which he had, or imagined he had. The doctors did not use herbs to cure him, but a tom-tom. The vibrations from the steady beat of the drum regulated Red Wolf's body and put it back into tune so he said. The old fellow had not always been an outcast. He could, if he felt in the mood, tell of the years he had spent in an eastern college, and under his touseled graying hair was a good bit of "gray matter," which he liked to use whenever he heard anyone arguing against the medicine-men.

Among the Loucheux Indians, in Alaska, I knew an old chap named John Blackfox. One day I saw him near the Indian graveyard chopping all the trees down between it and the river. I asked him why he was doing this and he told me of a very powerful medicine-man who was making evil medicine against him, and he was going to die. He had always loved the river and wanted to be able to see it after he was gone, so he was preparing a way. About four months passed and old John waited in vain for the evil medicine to kill him. Finally he could stand the suspense no longer and shot his head off with a gun.

IN every Indian tribe there were, and in some tribes still are, a number of men and women who are credited with supernatural powers which enable them to recognize, antagonize, or cure disease at will. But the Idnian magician and medicine-man are rapidly disappearing from the American continent. Many of their secret formulas and magic tricks have been lost within the last generation. And in the next twenty years civilization will have wiped out all trace of this extremely interesting art of the aborigines of America.

BUNGI MEDICINE MAN

The photograph was taken when he was "making medicine" by shaking a rattle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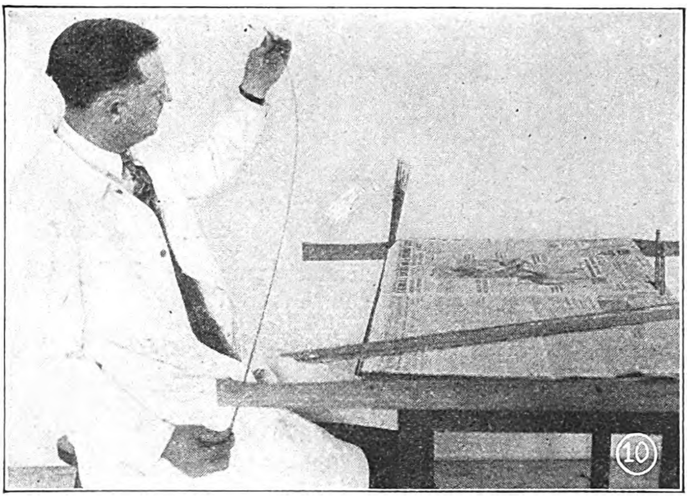
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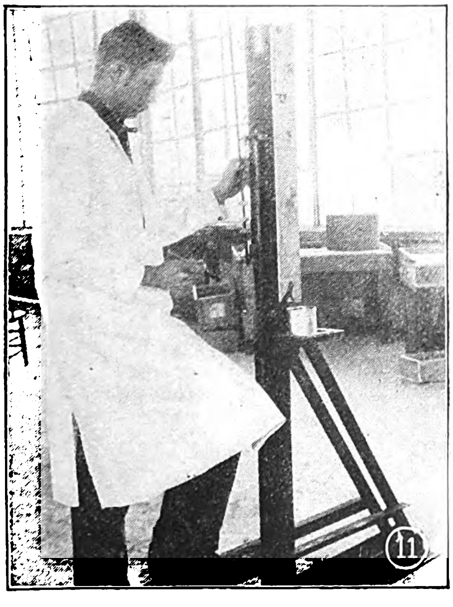
From Bamboo Forests to Fishing Rods

The Modern Split-Bamboo Fishing Rod Is a Far Cry From the Crude "Pole" of Boyhood Days

TO dwellers in Eastern lands, the bamboo tree furnishes frames for houses, material for rafts and boats, containers for water, food, and the like, and other necessities of life. To those in other lands where the pressure of necessity is lightened by a diversity of materials, the term "bamboo" usually conjures up a vision of split-bamboo sun-screens for the front porch, or—more likely—of favorite fishing spots where the bamboo rod reigns supreme. The barefoot boy of story and song whistled on his way to the nearby stream with a single stick of bamboo over his shoulder, bought for a few cents at the general store. The moneyed fisherman rolls smoothly in his car to the best trout stream or bass lake, and in the tonneau repose finely finished split-bamboo fishing rods, each a masterpiece of modern craftsmanship. And in between these two extremes are to be found all kinds of split-bamboo rods ranging in price from a few dollars to 50 dollars or more.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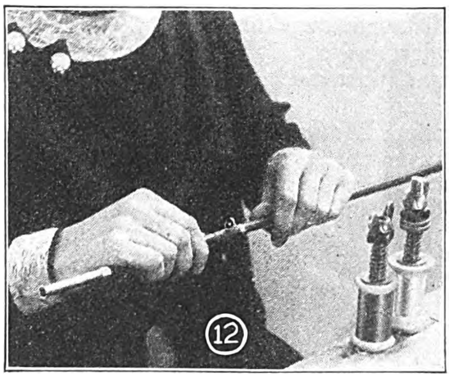
A good split-bamboo rod is such a thing of beauty and obviously hides within it such a display of expert workmanship, that we are sure many of our readers will be interested in the photographs on this and the opposite pages wherein are shown the various steps in the manufacture of rods of this type. These photographs are described in the following paragraphs.

Opposite page: (1) The preliminary work on the Chinese Tonkin cane, which is conceded to be the best for fishing rods. Sandpaper is used to remove the "nodes" or joints before splitting. (2) This machine will split the most crooked cane absolutely with the grain. (3) Here the strips are cut so that their cross-section is a perfect equilateral triangle. (4) The strips are straightened and cured. This rapid process is equal to 20 years of ordinary seasoning. (5) Sizing and tapering. The strips are cut to a uniform accuracy of one one-thousandth of an inch. (6) Glueing, the most important of all operations. In this machine, a temporary winding is put on to hold the strips while drying. Temperatures must be kept constant. (7) The end of the rod is shaped to receive the ferrule. (8) Setting the ferrule, which must be straight with the rod.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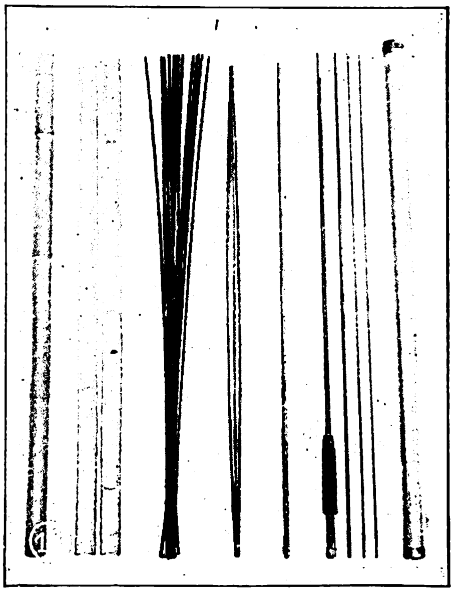
This page: (9) The finishing touches of straightening and trueing. (10) Inspecting and testing a tip section before winding. (11) Cork disks for the grip are glued in place and then shaped. (12) The guides are fastened in place with silk wrappings. (13) Steps in the manufacturing process from the raw cane to a finished rod and its protecting case. From left to right there are: the bamboo as it comes from the forest; the sand-papered cane, the split strips; the shaped strips ready for glueing; the glued rod with temporary bindings; the finished rod in all its quiet beauty; and the case for the rod.



The Guns Against the Airplane

New Anti-aircraft Matériel and Fire Control Methods Put the Airplane in its Place as an Important War Auxiliary

By MAJOR G. M. BARNES
Ordnance Department, United States Army

THE average American citizen has, I believe, decided that the airplane, which is daily being rapidly developed for commercial and military uses, will be an important weapon in the next great war. Large bombing planes have already been built which are capable of carrying 2000-pound bombs at high altitudes and for long distances. One readily imagines the destruction which could be spread over a country with such weapons. Swiftly flying planes mounting many machine guns can be pictured spreading terror and destruction as they fly low over cities, camps, or armies on the march. The possibilities for destruction seem almost unlimited, and some military enthusiasts have stated that the airplane will render obsolete all other types of weapons and methods of warfare on land and sea. In short, the popular present-day sentiment is that the next war will be fought in the air.

The airplane came to the front as an important arm of the service with great rapidity during the World War. Although in 1914 it was almost unknown as an instrument of war, in 1918 over 480 German machines were employed in attacks on Paris alone.

IN England the rise and decline of airplane raids is indicated by the following statistics: Up to the end of 1916 there had been 19 attacks in which bombs had been dropped. In 1917 there were over 26 attacks in which 51 tons of bombs were used, while during the last year of the war, due to the increased efficacy of the combined air and anti-aircraft defenses, there were only six raids in which 22 tons of bombs were dropped. The airplane was also found to be of invaluable service for reconnaissance, mapping, photographing, and for directing artillery fire.

During this period there were two principal means of defense against the airplane: other airplanes, and guns. It is not within the scope of this article to review the advantages and disadvantages of the two types of defense; suffice it to say that official records indicate that approximately five airplanes were destroyed by aircraft to one destroyed by gun-fire. In fairness to the anti-aircraft artillery it should be pointed out that the ground defenses were of the greatest assistance to the air defenses, since they aided in locating the enemy aircraft.

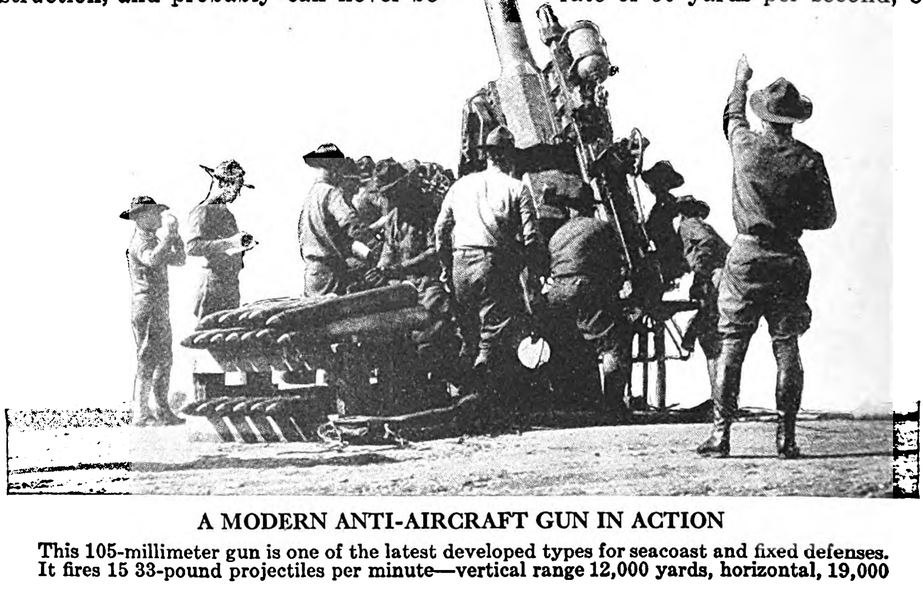
An observer on the ground usually can see more of what is taking place in the air than can one in an airplane. The shrapnel or shell-bursts of the anti-aircraft artillery were used to point out the enemy planes to the defending air forces. Also, in night attacks, the defending planes were helpless unless enemy planes could be located and illuminated by the searchlights of the ground defenses. Thus, many planes credited as destroyed by aircraft were really destroyed by the close co-operation of the air and ground defenses.

Looking back over the war period it is surprising to the writer that the crude anti-aircraft artillery and fire control existing at that time could have established such a favorable record. It is the purpose of this article to describe as briefly as possible the astonishing developments which have since been made in the art of anti-aircraft fire.

The principal rôle of the gun is to destroy the airplane, or to force it to climb to such high altitudes that it cannot accomplish its mission of obtaining information, taking photographs, bombing, or raiding. Few would question the ability of a three-inch or four-inch gun, firing high explosive shells, to destroy an airplane on the ground in a stationary position within effective range of the gun. The plane is of a relatively delicate construction, and probably can never be armored with plates of sufficient thickness to keep out the fragments of high-explosive shell, which depart into space from the point of detonation at the tremendous velocity of 4000 feet per second. The weight of such armor would be prohibitive.

It is unnecessary that the shell burst exactly at the plane, for the fragments extend outward from the point of detonation forming a relatively solid mass like a mushroom, the stem pointing in the direction of fire. An airplane 150 feet to the right or left, or 300 feet in advance of the point of burst would be within the effective range of the shell fragments. Thus the plane depends for safety on its great speed and the fact that it can move through space in three dimensions.

THE reason the anti-aircraft gun did not make a more favorable record in the World War can now be quickly stated. The gun of that period did not lack the range or the ability to reach the airplane in the heavens; it did not lack the power to destroy its target, but it could not find its target. Its shells exploded too high or too low, too far to the right or the left, too far to the rear, or too much in advance of the plane. The problem was one of time, with the target moving in space at the rate of 50 yards per second, or



A MODERN ANTI-AIRCRAFT GUN IN ACTION

This 105-millimeter gun is one of the latest developed types for seacoast and fixed defenses. It fires 15 33-pound projectiles per minute—vertical range 12,000 yards, horizontal, 19,000 more. All elements of gun laying, namely, direction, elevation, and fuse range, were changing with great rapidity. In attempting to place the center of impact of the fire on the target, it was natural that the methods successfully employed for controlling the fire of field artillery should be used first. These methods were soon found to be inadequate, and new ones of every description were tried. Attempts were made to calculate the future position of the target by various curves, slide rules, and the like. The approximate data thus obtained were telephoned to the guns, set off, and the guns fired as quickly as possible, with the result that the airplane, with average luck, continued on its way undisturbed by the rain of fragments far to the rear.

FIRING CLIPS OF FIVE SHELLS LIKE A RIFLE

The Browning 37-millimeter, full automatic gun firing at a towed sleeve target a mile away. It fires from 60 to 90 projectiles per minute, each weighing one and one quarter pounds

AFTER the war, the Ordnance Department of the Army, taking advantage of the war teachings, inaugurated the development and construction of entirely new weapons of all types. This work has resulted in new types of equipment for all branches of the service, greatly excelling the World War types. Anti-aircraft artillery and its fire control has also been extensively developed, and the new equipment represents a great advance.

In the new method of anti-aircraft fire control, it is necessary to know first the altitude of the airplane above the ground at all times. This is used instead of range. The aviator in the plane knows this altitude reasonably well from his instruments. It can be measured even more accurately from the ground by means of the stereoscopic height finder, an optical instrument developed especially for this purpose. The necessary firing data for the guns are computed automatically by the anti-aircraft director, a calculating machine which, if kept directed at the target by means of two telescopes, will not only continuously compute the range, speed, and course of the plane, but will also indicate continuously the elevation and direction at which the gun should be set so that it will point ahead of the target by the correct amount at all times. The gun must lead the target since the projectile requires several seconds to reach the plane.

Approved by Secretary of War

BEFORE sending this article to us, Major Barnes submitted it to army departmental heads for approval. When it reached us it had appended the recommendations of the Chief of Ordnance and the Chief of Coast Artillery that it be approved, and an order from the office of the Secretary of War authorizing its publication.

It was the good fortune of the editor of this article to witness at Aberdeen Proving Ground last fall anti-aircraft tests such as those described herein. In consideration of the excellent results obtained at that time, we believe that the author is conservative in evaluating the newer anti-aircraft guns and equipment. *—The Editor.*

GUN BATTERY COMPUTING MACHINE

This instrument tracks the airplane and controls the setting of the guns in an anti-aircraft battery

By means of this new calculating device the anti-aircraft guns are set to lead the target by an amount mathematically computed for the conditions existing, based upon the height, speed, and course of the plane at the time of fire. The artillerist will know that it is necessary also to make corrections for the drift of the projectile, the direction and velocity of the wind, the muzzle velocity of the gun, and the density of the atmosphere at the time of fire. The machine also computes these quantities and corrects the final answers in accordance with the known data.

Now if the gun could be continuously trained, say electrically, to follow the data indicated by the director so that no time would be lost, the gun could keep step with the movements of the target. This has recently been accomplished. The new guns, driven electrically, move in elevation and train by just the calculated amount to place the burst at the target. The other element entering into the problem—the time setting of the fuse to burst the shell at the proper point along the trajectory—is also computed by the same instrument. Here, again, the old artillery hand fuse setter has been abandoned for the new fuse setting machine, which is kept in step by means of an electrical data transmission system working with the data furnished by the director.

Many improvements in guns and ammunition have also been made. The new anti-aircraft guns have higher muzzle velocities in order that the shell may reach its target more quickly. The new projectiles have streamline shapes, which offer less resistance to the air. The fuses perfected for the field artillery for use in destroying targets on the ground, have been found to be erratic when fired into the higher altitudes, where the atmosphere is less dense. Clock fuses, which will operate with uniform accuracy, at all ranges and altitudes, will become a part of the new anti-aircraft matériel.

DURING the last four years some 20,000 rounds of ammunition have been fired at sleeve targets towed by airplanes, during day and night tests, with the new anti-aircraft guns and devices. The results with the latest weapons and fire control are very important, and bring one to the realization that the anti-aircraft gun will fill a decidedly more important place in the future. In the 1925 tests, towed sleeve targets were occasionally shot down. To shoot down the cloth sleeve towed at high speed by the bomber, it is necessary to cut the 3/16-inch steel towing cable by severing it with a shrapnel ball. (This is the type of ammunition used in target practices; the more destructive high-explosive shell would be fired in time of war.) During the 1927 and 1928 practices, targets at which 50 to 60 shots had been fired showed shrapnel holes almost without exception, and targets were frequently shot down.

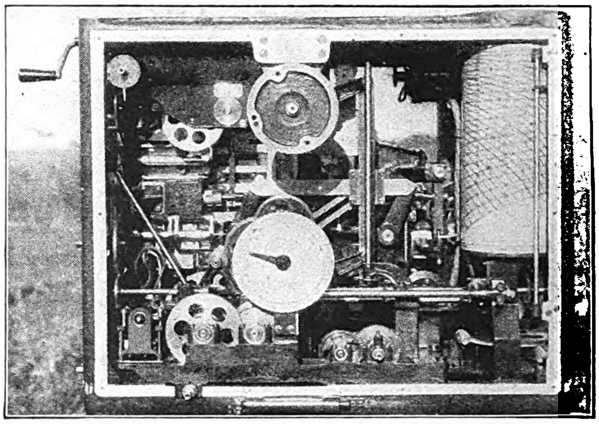
A NEWSPAPER correspondent, in an article written concerning a firing demonstration which he witnessed, praised the accuracy of the firing but pointed out that the range and altitude of the target were known to the firing battery. Nothing could be farther from the truth. The only restrictions placed as to the course of the target is that it fly over areas at the Proving Ground owned and patrolled by the government. The direction of the course of the plane must also be such that the pilot in the towing plane will not be in danger. It is of the greatest credit to the personnel of both the Anti-aircraft Artillery and the Air Service that, in the three years during which these extensive anti-aircraft firings have been conducted, day and night tests have been flown without accidents, and neither the aviators nor the planes have been endangered by the firing.

To those who doubt that the anti-aircraft gun has sufficient accuracy to combat aircraft, it may be of interest that the probability of bursting shells at a point near enough to the plane to be effective has been calculated, assuming no errors in laying the gun. Thus, at a range of say two and one half miles, if the gun is correctly laid continuously, the probability of a shot being effective is about 38 percent; and at a range of four miles, 25 percent. These percentages would be greater for the four-inch gun. As the actual percentages now obtained are about one fourth as much, here is an indication that future progress in fire control will result in increased accuracy, even though no other improvements be made in the gun or its ammunition.

While the tests were conducted to obtain the best possible data concerning the accuracy of the anti-aircraft fire, it is of course impossible to simulate the conditions which will prevail in time of war. The aviator would naturally take steps to protect himself by using smoke screens and by flying zigzag courses. These measures would help the aviator to avoid destruction. However, as to concealment, and zigzag flying, it must be remembered that an anti-aircraft battery on the ground would be difficult to detect from the air two to four miles away. The aviator will not know when he is coming under gun range unless he has knowledge of the location of the battery.

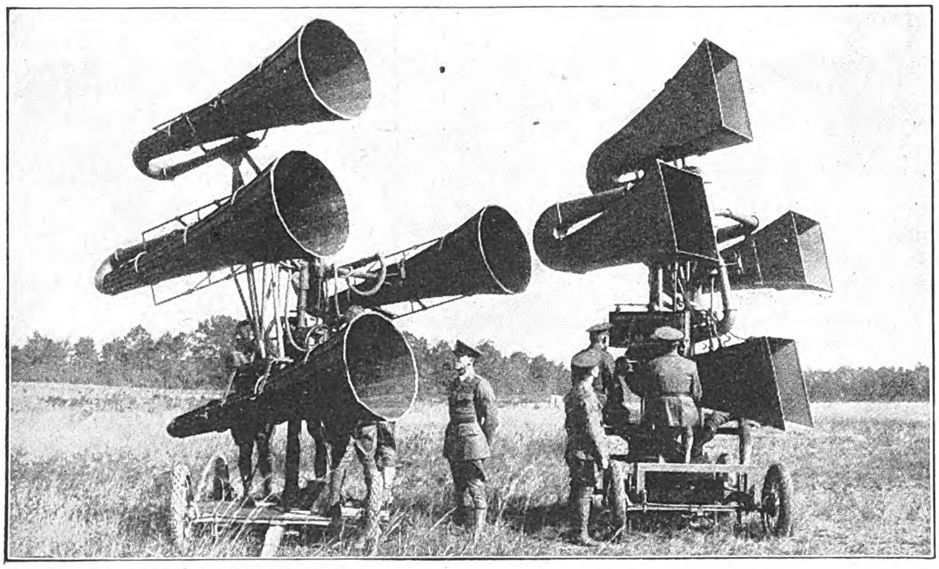
A four-gun battery of three-inch guns will deliver an average of 100 shots per minute. When the aviator sees the first burst, if at a range of approximately two and one half miles from the battery, there will be more than 16 shots already on the way toward the plane. Adverse weather conditions usually favor the gun, since the aviator must see in order successfully to attack a ground target, using bombs and machine guns. He must fly below the clouds and thus come closer to the anti-aircraft guns.

AT night the airplane can be detected by the noises made by the engine and the swishing of the air past the machine. The listening horns, or sound locators, as they are known, can track the plane by sound. Up to date these noises, which give away the position of the plane to the ground troops, have not been eliminated. The supercharger which is being developed to



COMPUTING MACHINE MECHANISM

The complicated works of the new apparatus which calculates location, speed, and course of the target

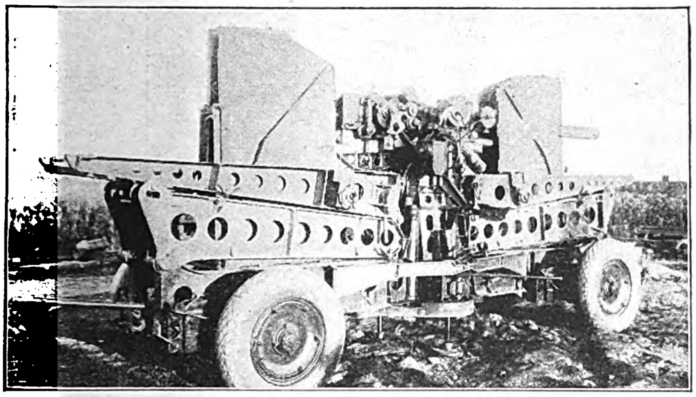


DIRECTION FINDERS

Improved sound locators with which an airplane up to 12 miles away can be heard

STEREOSCOPIC HEIGHT FINDER

The sighted airplane is the apex of a triangle, of which the base and its two adjacent angles are known (distance between the telescopes, and their declination). The rest is mathematics



A MOBILE THREE-INCH GUN

A post-war development. The gun and its entire equipment is constructed so that it can be quickly folded away on its trailer

MOBILE THREE-INCH GUNS IN ACTION

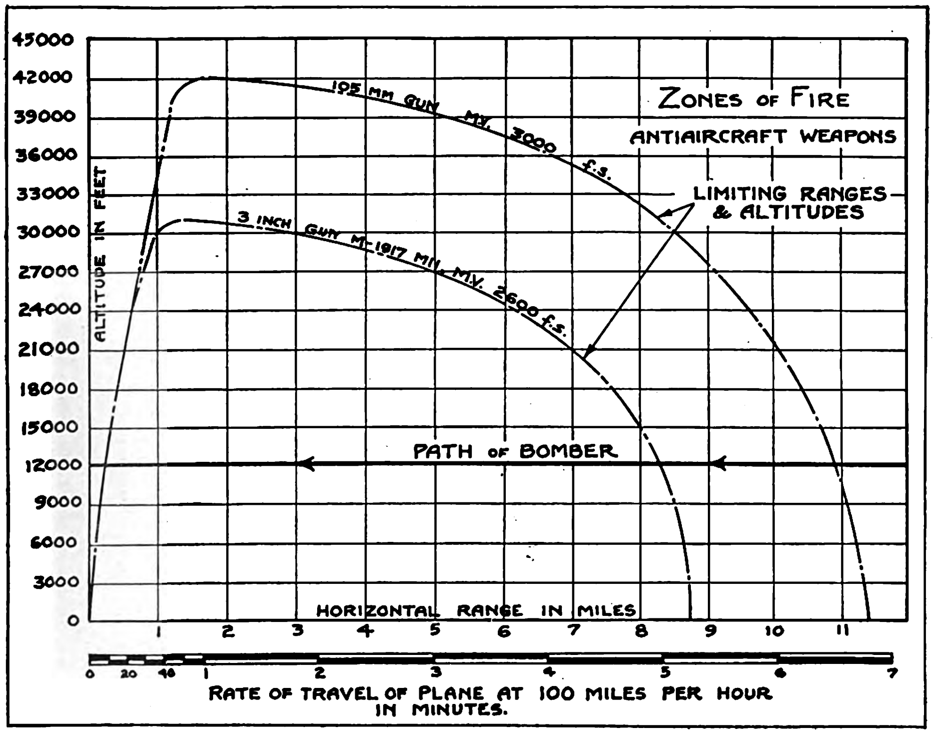
A battery of guns, of the type shown at the left, in action. Each of these guns fires 15-pound projectiles at the rate of 28 a minute

allow the plane to fly at higher altitudes, seems to increase these noises.

The sound locator gives continuously the approximate location of the plane. Powerful searchlights, electrically controlled, search around the moving point indicated by the horns. The plane, once picked up by modern searchlights, cannot rid itself of the beam by diving, twisting, turning, or other maneuvering. Frequent tests have verified this to be a fact. When the target is once illuminated by the searchlight, the same methods of firing are used as those employed for day fire.

The defense against bombing planes at night is by no means perfect. The airplane has a chance to evade the horns, especially if an insufficient number is present for the defense of the area. On the other hand, night operations also offer great difficulties to the aviator, who is flying over unknown territory in the darkness.

For bombing aircraft flying at the lower altitudes, the three-inch gun is ideal, and tests have shown that the gun can follow the target successfully as it rushes past the battery at ranges of less than a mile. However, machine guns, being much lighter and mobile, are important anti-aircraft weapons for ranges up to one and one-half miles. Four machine guns mounted together on a single mount, each mount firing 500 shots per minute, can literally spray the target with machine-gun bullets. Attempts were made at first to shoot the machine gun by the eye, or by roughly calculating the amount of lead, on improvised instruments. To get a satisfactory percentage of hits with machine guns, it has been found necessary to use accurate fire-control instruments similar to those used for directing the fire of the three-inch gun.



VERTICAL AND HORIZONTAL ZONES OF FIRE

The 105-millimeter gun can throw a projectile to a height of over seven miles and, horizontally, over 11 miles; the three-inch gun nearly six, and nearly nine miles, respectively

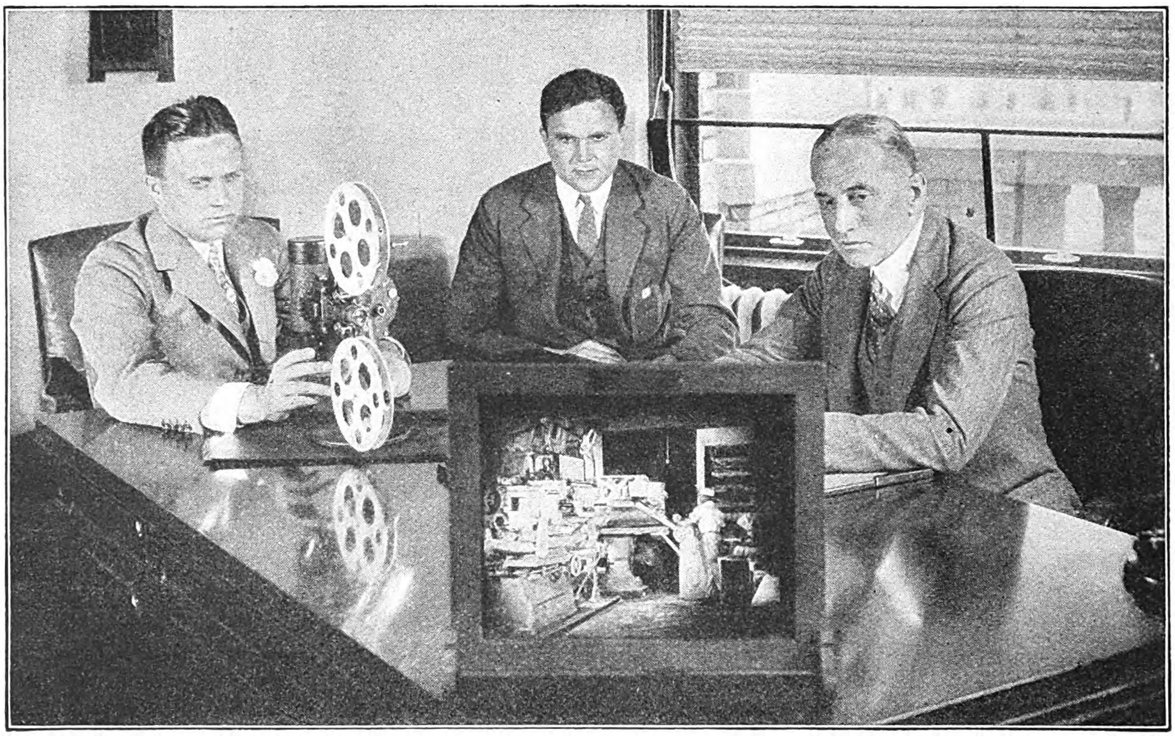
A new anti-aircraft weapon of great promise is the 37-millimeter, full automatic gun, firing about 90 one and one-fourth-pound projectiles per minute per gun. This shell is equipped with a special fuse to operate on contact with any part of the airplane, and a single hit with this weapon may destroy a wing or other vital part of the airplane.

From the advance which has already been made in anti-aircraft fire, it is safe to predict that anti-aircraft weapons of all types will become more and more effective as time passes.

DUSTY ACTION

Rapid firing of 105-millimeter anti-aircraft gun causes much dust due to concussion

The writer does not contend that the airplane will be unable to take to the air due to artillery fire. Field artillery can now successfully destroy infantry, but under certain conditions the infantry advances. However, the prevalent idea that the airplane will, in future wars, ride roughshod over all existing defenses unscathed will, as years go by, be forgotten, and the airplane, like the submarine, the tank, and the gun, will takes its place as an important auxiliary tool in the complicated and ever-changing machinery of war.



THE EXECUTIVE'S DESK BECOMES A STAGE

An up-to-date salesman equipped with industrial films, a portable projector, and a "daylight screen" demonstrating his wares on the mahogany desk in his prospective customer's office, showing one scene from the picture

Putting It Over With "Movies"

Advertisers Adopt the Use of Motion Pictures to Promote Good Will, "Educate" Prospective Clients, and Sell "Hard-to-Advertise" Products and Service

By HENRY W. HOUGH

BUSY executives, street loiterers, housewives, and casual theater-goers are now finding themselves recipients of the attentions of advertising men who "put over" their message in an unusually pleasant form. Most people still consider "movies" as a rather pleasant diversion. This fact, aided by the rapid development of portable projectors, daylight screens, and a wide variety of well filmed industrial motion pictures, has created a new era in advertising. The public is now being "entertained" with the carefully prepared and often costly creations of enterprising business and industrial leaders.

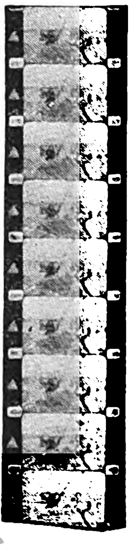
Broadway's most regal "movie" palaces have recently presented some outstanding pictures of this type, produced by Visugraphic Pictures, Inc., for the New York Stock Exchange, the Radio Corporation of America, the New York Edison Company, and other prominent firms. What is good enough for Broadway is good enough for Main Street, and most of the theater-goers of the nation will eventually see these pictures in their own local motion-picture theaters.

There are about 21,000 moving picture theaters in the country, and more than 65,000 non-theatrical exhibitors of motion pictures, all of which present a potential market for well produced industrial "movies," especially if there seems to be unusual educational value to the films. Incidentally, it has been computed recently that there are in this country about 100,000 homes equipped for exhibiting the smaller size or 16-millimeter films.

INDUSTRIAL films are classed by their producers as selling, technical, propaganda, and educational pictures. In addition to these there are the object lesson pictures of the type produced by the United States Bureau of Mines for instructing employees in first aid and safety measures.

Many business firms are using "movies" of the 16-millimeter size to exhibit their products or service. Anyone can take such pictures, and this type of display, with portable projecting apparatus, is particularly popular at conventions, in lobbies and store windows, and for demonstrations in the home or office of a prospective client. "Hard to advertise" subjects, such as heavy machinery or intricate processes, are very effectively portrayed in a single reel of inexpensive film.

An example of this type of industrial movie was seen in the booth of the Wailes Dove-Hermiston Corporation at several recent conventions. This firm had a capable amateur take moving pictures of the construction of the 340 mile pipeline that now carries natural gas from Amarillo, Texas, to Denver, Colorado. The film showed the variety of field conditions along the line, and clearly exhibited the method used in applying hot Bitumastic enamel as protection against corrosion, just before laying the pipe in

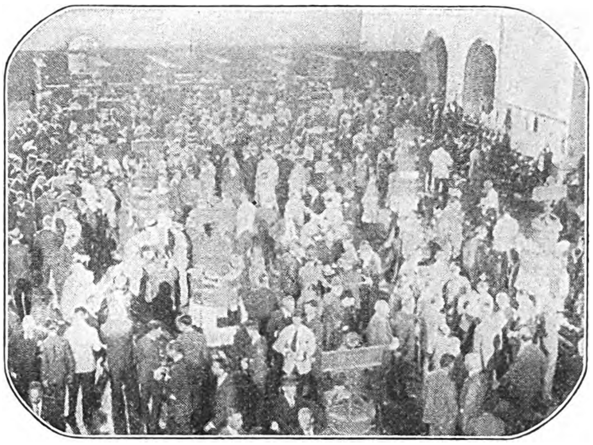


16-MILLIMETER FILM

Strip of film from an advertising "movie" showing actual size of the 16-millimeter film widely used by amateurs for producing industrial pictures position on the floor of the trench.

When an advertiser intends to use industrial "movies" for wider distribution, the standard size film (35 millimeter) is usually used. Almost all amateur motion pictures are taken on 16-millimeter film of a type that is developed by the "reversal" process, rather than by making duplicate "prints" from the original negative. At least one manufacturer makes 16-millimeter film from which any number of "prints" can be produced, but for the more pretentious industrial "movies" the larger size is used almost exclusively.

Of course the use of duplicate prints makes possible much wider distribution of the films, particularly in view of the fact that theaters and most of the non-theatrical exhibitors are equipped with projectors designed for 35 millimeter film.



BULLS, BEARS, AND PAGES AS ACTORS

A "still" from the Visugraphic Stock Exchange film "The Nation's Market Place," a favorite on Broadway

FOR these more costly productions it is customary to engage a firm or agency making a business of producing industrial moving pictures. Since those paying for the "movies" are thinking of the investment in terms of advertising value, the cost of the production is of small consequence. For this reason, industrial "movies" are now made with the technical skill and attention to settings that one expects of regular commercial moving pictures, or "features."

The film, "The Nation's Market Place," produced by Visugraphic Pictures, Inc., for the New York Stock Exchange, cost about 15,000 dollars and entailed almost insurmountable obstacles inasmuch as it was taken on the floor of the Exchange during a customary session. This picture runs in about fifteen minutes, and has already been seen by more than 5,000,000 people.

Another Visugraphic picture that has "played" at Roxy's and other theaters on Broadway, as well as on countless minor "Broadways," is the film "Man Made Miracles," showing how radio tubes are made in the factory of the Radio Corporation of America. This film has a number of interesting features, aside from the story it tells. By showing certain processes in "slow motion," the lightning-like movements of certain operators can be analyzed, showing the value of slow motion pictures for research and improved practice in industry. In order to show flame in color in certain scenes, it was necessary to paint in the colors on each exposure—painstaking work, and expensive. The captions or sub-titles of several prints of the films have been translated into Spanish for exhibition in Spain during the Barcelona Exposition, and in various countries in South and Central America.

FAST WORK IN "SLOW MOTION"

Lightning-like movements of skilled workers are analyzed and studied by reproducing in "slow motion"

The United States Government, through the Bureau of Mines, of the Department of Commerce, is one of the largest producers of industrial moving pictures. The "government pictures," as they are known to exhibitors, are paid for by the particular corporation that co-operates with the Bureau of Mines in making the film. More than one million dollars has been appropriated by the mineral and allied industries to carry on this work.

"The preparation of the scenarios for these films, as well as the actual production of them, is supervised by engineers of this bureau," according to M. F. Leopold, Supervising Engineer in charge of the Motion Picture Production Section of the Bureau of Mines. "The entire cost incidental to the actual production of a picture and that of providing a sufficient number of copies for circulation, is paid for in each instance by the co-operating agency.

"In the production of these films we do not permit any trademark, tradename, or any other material which may be construed as advertising to appear in any part of the picture. In addition to the government title which appears on these films, there also appears a short courtesy title giving the name of the co-operating agency."

CONVINCING THE HOUSEWIFE

Enterprising salesmen find that housewives have time to witness advertising "movies" in the home

AMONG the firms using moving pictures for promotion and educational work, either in co-operation with the Bureau of Mines or by arrangement with commercial producers of industrial "movies," the following organizations and their films are particularly noteworthy:

National Coal Operators Association, "The Story of Coal"; Westinghouse Electric Company, "Water Power"; United States Steel Corporation, "The Story of Steel"; American Petroleum Institute, "The Story of Petroleum"; and films of the American Gas Association, H. L. Doherty and Company, General Electric Company, Buffalo *Evening News*, Metropolitan Life Insurance Company, the United Press Associations, and the Government of Chile.

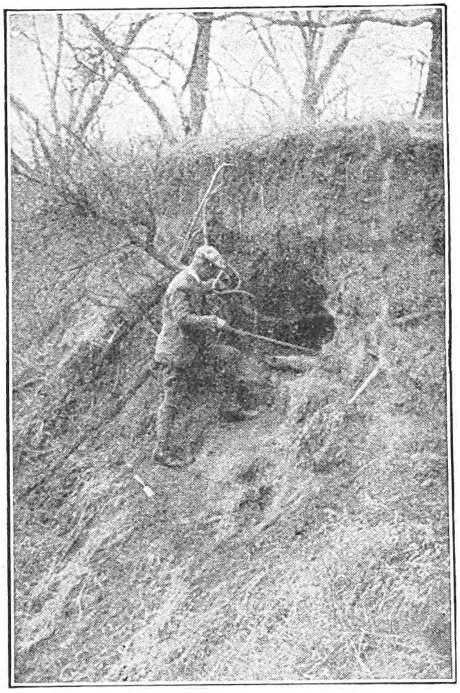
Arrangements were made recently with the Theater Owners Association of Quebec for exhibiting one of the Bureau of Mines safety films, "Carbon Monoxide—the Unseen Danger," in the 147 theaters of the Association. The Japanese government has purchased four of the Bureau of Mines films for use in conjunction with a general safety campaign in that country.

At the present time all classes of industrial motion pictures are furnished gratis to exhibitors in this country, it being understood that the exhibitor is to pay all handling charges.

New Evidences of Ancient Man in America

Unusual Skeletal Remains Recently Discovered in Texas Suggest Further Investigation Before the Hypothesis of Ancient Man in America Is Abandoned

By DR. CYRUS N. RAY
President, Archeological and Paleontological Society of Texas



SITE OF THE FIND

The author pointing to the hole in the bank. No artifacts were found there

IN August, 1927, I read an article in the SCIENTIFIC AMERICAN which described the discovery of evidences of prehistoric man in the southwest. It then occurred to me that such evidences might also be found in the locality of Abilene, Texas, where I reside. An intensive search was begun, which has since used up the time of my available holidays.

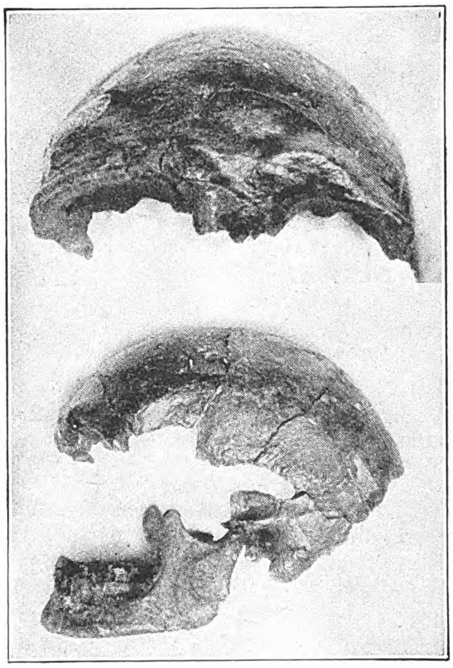
Prior to this time it had been the general opinion that evidences of primitive man were scarce in this section. The contrary was found to be true. Within the short period of a few months I have collected thousands of stone artifacts which vary greatly in form and type, as well as chemical alteration or patination.

SOON after the search was started, a fossil skull having primitive features, also two fossil beads, were discovered. In addition, portions of thick skull plates were found where they had been left exposed by deep holes which the wind had blown into the local sand-dune land. These and other evidences of ancient camp sites were always found in sand-dune land near springs or where springs possibly had been in the past, but in situations now located several miles from water.

One flat frontal bone, having heavy, beetling supra-orbital ridges, previously taken from this culture, is owned by Simmons University. A photograph of this was obtained through the kindness of Prof. D. W. Arnett of that institution, and is reproduced in the present article.

With the encouragement provided by this fossil, the hope persisted that a complete skull of the same flat-headed type might eventually be found.

While at the Lamb's Head Ranch, owned by Mr. J. A. Matthews of Albany, Texas, I met a cowboy, Mr. Bob Bradford, who told me of some bones which were protruding from the side of a high bank over the Brazos River.

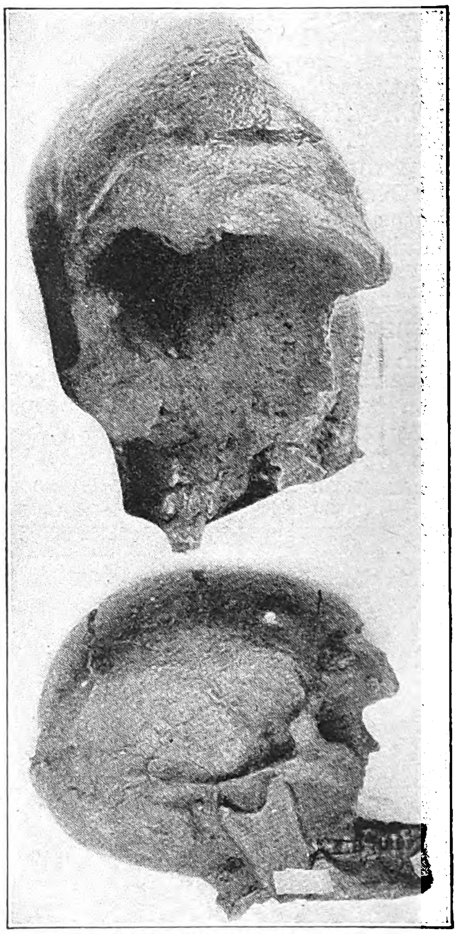


ONE OF THE SKULLS

The vault is low and the eyebrow ridges pronounced, but the chin is prominent

On arrival at the site we found a steeply sloping bank 40 feet high. Below a depth of five feet, ten inches from the top soil, three large, flat limestone rocks were seen to be slightly projecting from the bank. Two of these stones lay flat on either side and the third lay over the space between them. From this middle space projected the upper ends of two human femur bones. The soil had been disturbed but a few inches over the bones, as though a shallow burial had been made and then later the 70 inches of soil had been stratified over them.

Before removing the bones, a sketch of the position was made. Notes were taken of the color and texture of the soil of the six horizontally laid strata above the grave. In the latter, the stratification was perfect, showing different colored layers which had not been broken through or disturbed. Number 1, the uppermost, was composed of six inches of top soil humus having a chocolate color. Number 2 was composed of 15 inches of reddish-brown clay loam; Number 3 was of five inches of chocolate colored clay loam; Number 4 was of 11 inches of sandy loam of light tan color; Number



THE OTHER SKULL

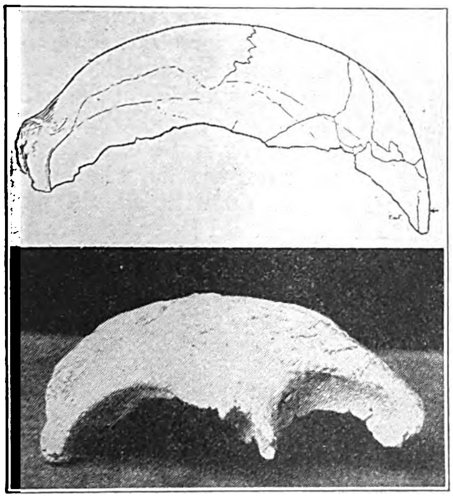
This was deformed by the weight of a superincumbent rock. Note heavy eyebrow ridges on both of the crania

5 was of 13 inches of dark brown clay loam; and Number 6 was of 33 inches of sandy clay loam of light tan color.

The burial was in the last 13 inches of the last named layer, Number 6. The bank where the burial was made faces the east. The body had been folded together at the hips, jack-knife fashion. The excavation began at the hips and as we dug in from the east we found the thigh and leg bones and forearm bones on the south and the pelvic fragments and lumbar vertebrae on the north. Farther in on the north, were found the lower dorsal vertebrae and many rib fragments.

All of these bones were found under the first three large rocks which had been seen projecting. Three more large rocks, lying in the same relative positions, were next removed. Under these were found parts of the upper dorsal vertebrae, most of the cervical vertebrae, both collar bones perfectly preserved and parts of the scapulae and ribs.

Under the large, flat, middle stone was found a complete skull and lower jaw with all the teeth. This skull was lying flat under the stone which had crushed it. The vault of the skull had parted in the center and the right side had been thrust up, overlapping the left or lower side. This side-flattened, crushed condition gives the pictures of the skull an apparent added height which is the result of distortion. If restored to its original outlines, this skull would be as flat on top as the other one. The skull was cleaned on the outside, leaving the clay matrix inside to hold it together, as found.



TWO SIMILAR CALVARIA

Above: from Clear Creek, Arkansas; courtesy of *Science*. Below: frontal bone at Simmons University, Abilene, Texas

About five feet away, in the same stratum, rib bones were seen to be projecting. At this place the almost vertical face of the bank had caved off on either side, leaving a narrow mass of projecting, stratified soil in the center. Below this, lying far down the steep bank, were six large, flat rocks similar to those taken from the first grave. Between these were also some rib fragments which had dropped from above. Evidently these stones had slid down from a cave-off of another burial.

On digging into the shoulder of remaining stratified soil, many fragments of vertebrae, ribs, and leg bones were found. Also, farther in the bank an almost complete skull top with a complete lower jaw and teeth were discovered. This lower jaw, like the other one, is of massive construction with heavy teeth. Both jaws have chins and both have small mental tubercles.

The tops of both skulls are decidedly flat; in fact these people had very little skull space above the eyebrow level. The skull bones of both are unusually thick. This is also the case with the long bones.

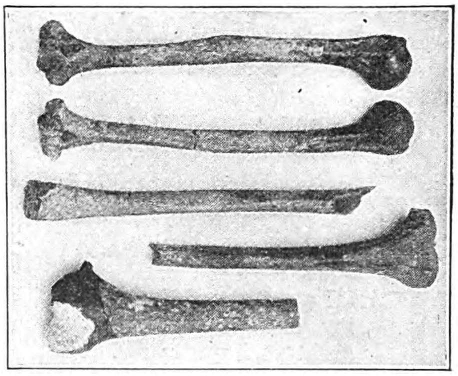
The radius and other long bones have some peculiar curvatures which may be noted in the pictures. I wish to call attention to the articular faces at the knee joints. A cross section of the shin bone or tibia, taken at about the middle of the shaft, shows a much flattened outline instead of the modern triangular one.

An Unknown Race?

WHETHER the author of the accompanying announcement has discovered evidence which may establish the existence of a hitherto unknown type of early man in America, can be decided only by the professional anthropologist. Certain characteristics of the crania have suggested to him Neanderthaloid affinities, as stated in private letters to this journal. However, he has resisted the not unnatural temptation to publish such a startling claim. It is nevertheless possible, as Keith, the anthropologist, states, that there have been many more races of man in the past than we now know of. —*The Editor.*

Of the skeletons two humerus bones were found whole, three clavicles are complete and several cervical vertebrae almost so. Enough of the shafts and the articular facets of both ends of both the femur and tibia were found to reconstruct both bones. One radius is complete, three patellas are intact. Most of the bones of a foot were preserved, including some small terminal phalanges. The bones of both skeletons are mineralized or petrified. Some are quite heavy and hard and give out a resonant clink when knocked together.

Mr. J. A. Matthews has lived near the place where the bones were found, since 1852. He stated that in that period the river had been out of its high banks five times, once in 1876, twice in July 1895, once in 1900 and once in 1922. The ground where the burial was made is much higher than that back of it for a considerable distance. In fact, it is one of the highest points close to the stream along that portion of the river. Considering the infrequent intervals indicated when overflows have occurred, it must have taken a long period of time to lay down the strata of soil over these burials. The same strata are exposed over a distance of 100 yards or more.

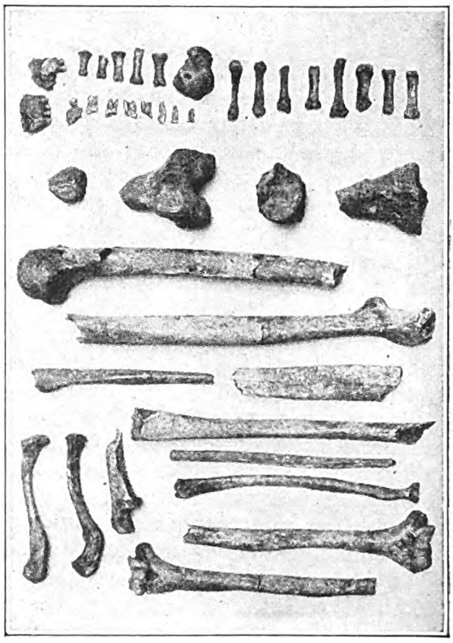


LONG BONES

Two humeri; two tibiae; femur. These and others show various aberrent tendencies. One joint has been chalked

In another place a layer of small stones and shells in the burial stratum may or may not indicate a former camp site. In a gravel stratum about 25 or 30 feet lower, were found the mineralized skeletons of two large animals.

I believe this general region should be studied by those seeking evidences of primitive man in America, and professional anthropologists are invited to come here and see the mass of evidence that has been accumulated, and to visit the sites where the objects have been found.



TEETH AND TIBIAE

A cross-section of the tibia does not correspond with any shown by Keith

Scientific Examination of Paintings

Mute Evidences of Authenticity Yield Their Testimony to the Skilled Scrutiny of the Scientist

By FRANCIS P. MANN

THE question of the authenticity of works of art is of the greatest importance. In the last 25 years the values of paintings in particular have become greatly enhanced and canvases worth half a million or more are constantly changing hands. Just recently we have witnessed the trial of a celebrated and titled dealer who was sued for 500,000 dollars for "slandering" a painting nine years ago. The public showed so much interest in this suit, which occupied columns of space in the newspapers, that possibly our readers would like to know how a painting is examined and, in a later article, how fraud may be guarded against.

The picture of today may be the museum piece of tomorrow. Formerly, the expert examined a picture by the unaided eye, or it was thought enough to make a photographic enlargement of the picture. But at the present time, pictures are put through an examination in the laboratory, in which many of the resources of science are called into play.

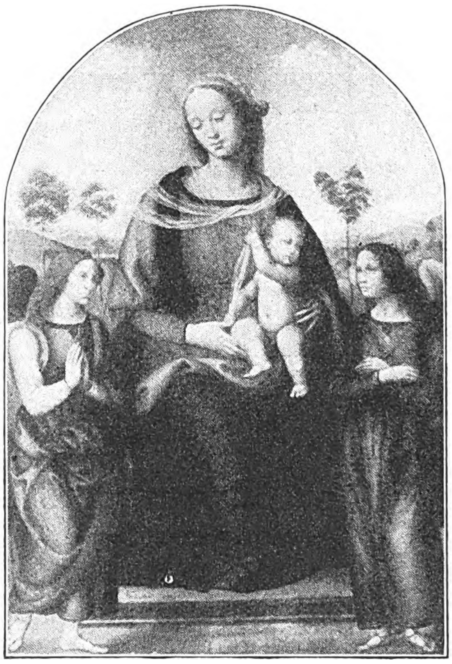
IN order to show what can be done in the way of identifying pictures, we will give a brief account of the examination of a supposed Raphael which was carried out in Paris by a leading scientific expert, Mr. Edmond Bayle, Director of the Judicial Identity Department, aided by Messrs. Henri George and Augustin Maché.

The picture was painted on a wood panel, and, as shown in our photograph, it represents the Virgin and Child, with two angels. Its height is about two feet, six inches. The upper garment of the Virgin is red, and the lower garment blue. The angel on the left has a blue tunic with green sleeves, and a robe of a blue-violet color; the one on the right has a blue tunic with pink sleeves and a green robe. The picture is signed and dated: Raphael Vrbinas F MDIII. The "F" stands for "*fecit.*"

To properly examine the wood of the panel, the experts took off small splinters from the backs of the boards composing the panel and then made sections for microscopic examination. This shows the structure of the wood. They also made a microchemical test to show the nature and the present condition of the cells. They found that the boards all belong to the same species, *Cedrela odorata*, and that they are all of the same age, several hundred years old, a valuable fact in itself.

Cedrela odorata is a variety of mahogany which was well known at the time of Raphael and was obtained from India through the Mediterranean ports. It was used principally in Italy and Spain for high-class construction, and it is well adapted for artists' use, as it has a fine grain and is hardly attacked by insects.

The drawings at the bottom of the opposite page show the structure of the old wood as compared with recent wood of the same kind. The age of the wood is apparent from the shape and the general arrangement of the cells, and especially the appearance of the cells, as well as their chemical state. It will be noticed that the cells of the old wood have shrunk and the walls have fallen in, so that they have lost their geometrical form. Due to the slow action of time, the veins have separated from the surrounding part and appear isolated.



QUESTIONED PAINTING
This is the example cited in the text for the explanation of the methods employed

When examining any sample of wood of a known age, it is observed that the action of time is continuous, and that for a given variety of wood, the same value of alteration corresponds to the same age, so that in the present case, several centuries have elapsed since the tree was cut.

At what time was the panel made? The experts found that the wood was in a well-dried, unused state, when the panel was put together. In fact it is shown by X-ray examination that the boards were assembled by simply glueing the edges, and the wood must have been perfectly dry at the time, or else it would not have remained in place. From what is known about the drying of wood, they estimated that the wood was at least 50 years old when the panel was made up.

Another point is that there were quite a number of worm holes in the panel. These holes are perfectly circular, and prove that the panel had been put together when the wood was first attacked by the worms; that is, the panel was made of newly trimmed boards, because when we cut up old wood that is already worm-eaten, we necessarily cut at angles across the cylindrical holes made in all directions through the wood.

IT was found that the wood had been covered with a layer of paint before it was attacked by worms. There are no holes at the level of the painted surface, as an X-ray examination showed. On the fluorescent screen the holes appear as small bright points.

Turning to the question of the painting itself, it is to be asked whether the picture we see now is the one that was originally put on; that is, whether the experts had to do with an old panel covered with an old layer of paint, on which a picture had been painted at a recent date. A flake of the white backing layer of the visible painting was taken off by a needle point, and this was put through a spectroscopic examination. The back part of the coating is found to be calcium, and this is in conformity to the old practice in which lime was used for the backing layer.

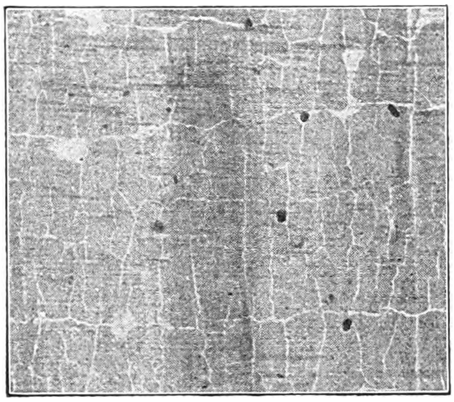
The character of the painting was next examined. Small cotton wads soaked with alcohol were rubbed over the painting, thus removing a microscopic amount of the pigments, which was enough for an examination.

It was found that the blue color of the Virgin's principal garment contains "lapis lazuli" (or mineral ultra-marine blue) and not artificial ultra-marine blue. But lapis lazuli as a pigment has been obsolete for a long time. Even in Raphael's time it was sold for its weight in gold; in fact, gold was used as the actual weight on the scales, the color being enclosed in small quills. The ultra-marine color was consecrated to the Virgin, and in view of its high price, it was customary for the client to furnish the painter with a suitable amount of the ultra-marine when ordering a picture dedicated to the Virgin Mary. However, in this garment there is mixed with the ultramarine blue a pigment which consists simply of indigo, which tends to show that the artist was too scantily provided with the fine color and had to eke it out, as was often done, with an inferior color. In the upper garment, mercury was found; the polariscope shows that the pigment has the crystalline form, so that cinnabar is the color here used, as was customary with the old masters.

THEN the picture was examined in the dark by ultra-violet rays, and the experts saw, contrary to what was expected, that the picture was slightly and uniformly lighted, each part keeping its own color. This can only be explained by the presence of a uniform layer of a fluorescent varnish, which thus indirectly lights the whole subject. This fluorescent [layer could not be removed without risk of damaging the picture itself, and this therefore means that the layer is intimately incorporated with the substance of the picture. Now, the experimenters were familiar with old paintings of various epochs in this respect, and concluded that the effect could only have been produced by a very long action of time. Hence, the age of the picture became still more evident.

Further characteristics of ageing were then examined. The natural cracking of a picture is due to the action of time, and the aspect of the cracked surface varies according to the use of varnish as a drying oil. Oil itself has peculiar cracks which vary with its nature, and as a rule the cracks will vary with the process used by the artist, who employed one or another vehicle for grinding up his colors and in mixing them on the palette. The old masters' paintings showed cracks which are peculiar to them. Also, it is one of the new ideas to show that the cracks vary with the backing, and are different according to the use of wood or stretched canvas. The depth of the cracks also increases with the time.

All this will show the importance of the study of the cracks and why the imitators take so much pains to imitate them. To fake a whole set of cracks on a picture, it is the custom to trace them off the real picture and then transfer them to the painting itself, which is first prepared by making small pin scratches upon it. Then the picture is heated in an oven to the proper temperature, thus producing deep cracks on the lines which have been marked out or started by the pin scratches, and these have the appearance of the natural cracks. By an X-ray examination it was shown that the large veins or knots in the wood will affect the general arrangement of the cracks. In the present picture, each vein of the wood is seen to correspond to a change in the aspect of the cracks, so that these cracks must necessarily be considered as genuine.



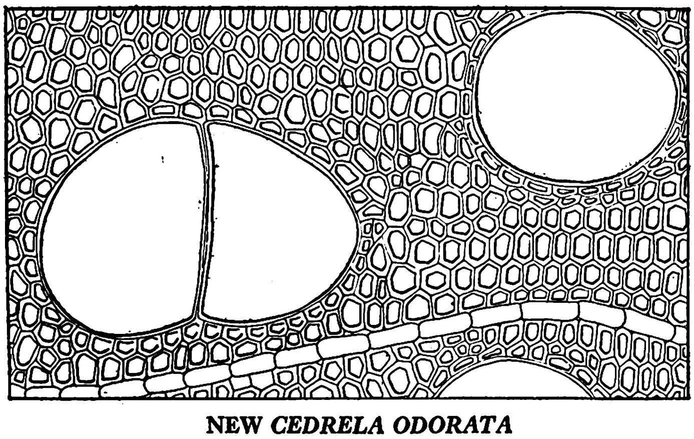
CRACKS TESTIFY

The fact that the system of cracks extend through the brush stroke of the signature (dark stripe in the center of this X-ray view) indicates the painting's authenticity

Next came the age of the successive restorations. This point can be well determined by an X-ray examination. As already observed, depth of the cracks depends upon the age of the painting. Under the X ray, the cracks appear as small lines which are sharper and clearer as the cracks are deeper. To compare the two crackled parts as to their depth, the tonality of a given region is compared. This examination clearly shows the position and the limits of the restorations, which have a general lighter aspect than the original painting. If it is considered that all cracks are shown up by photography, while in the case of the X rays the visibility of the cracks varies according to their depth, it is found—and this is a recent discovery—that the simultaneous examination by photography and radiography will afford exact data as to the age of the different parts of the painting. This, of course, applies principally to restorations. The authorities found that the painting had been restored at different periods, and this is a point in its favor.

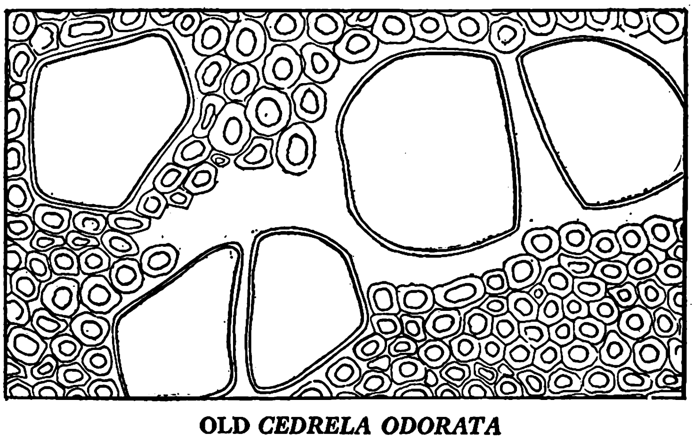
NO painted subject was found underneath the present picture, nor was there any alteration of the character of the painting by improper retouching. To sum up the results of the whole investigation which bore upon many other points that we are obliged to omit, it was shown that the painting had all the character and the peculiar features, as well as the age of the old masters, and the period which may be assigned to it corresponds very well to the age which was found for the wood panel itself. Everything, therefore, points to the authenticity of the picture, as to age and physical aspects.

Modern expert examination of paintings considers the following major questions: First, with canvas the nature of the fiber and its impurities, or the nature of the wood panel if the subject be painted on wood; second, the basic coating on the canvas or panel; third, the mineral matter in such coatings. Then when the artist comes on the scene, we can examine the nature of the pigments which the painter used. Strange to say, quite a bit of information has come down to us on this subject in printed form. Great attention is paid to the possibility of another picture being underneath, as well as to restorations, wise or unwise.



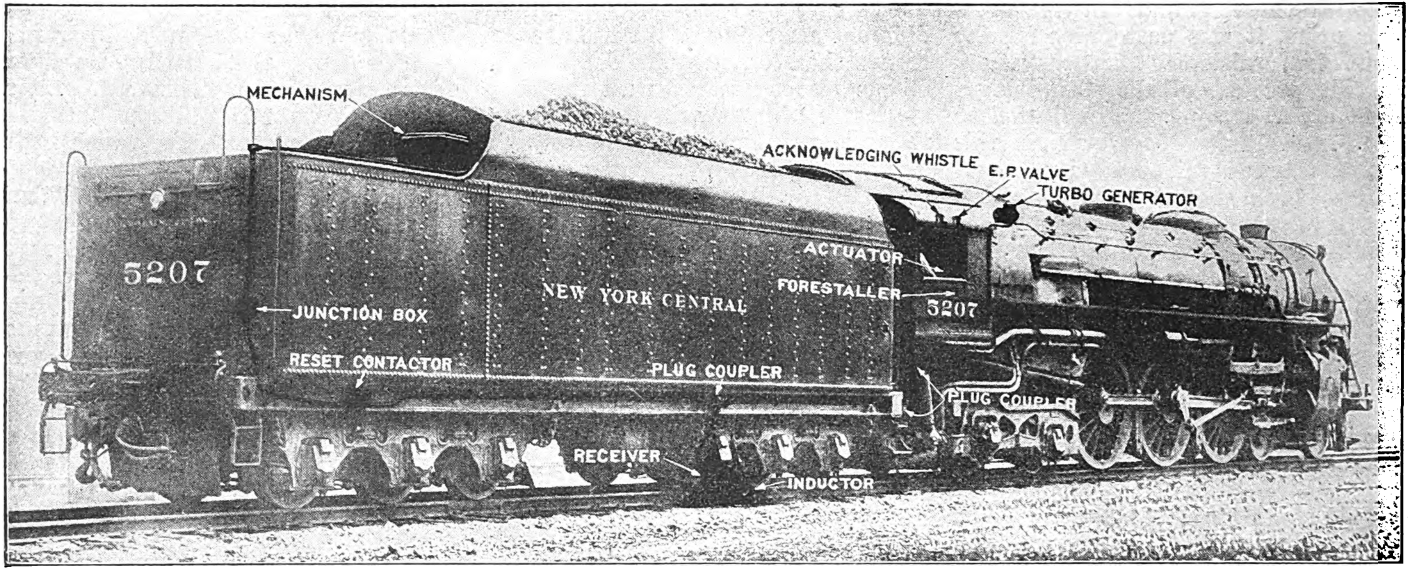
NEW *CEDRELA ODORATA*

The cells of the wood are in their pristine state, and are closely grouped around veins (large openings). See drawing at right



OLD *CEDRELA ODORATA*

The cells have shrunk and lost their original formation. They have also separated from the larger veins. Compare with drawing at left



PACIFIC TYPE LOCOMOTIVE EQUIPPED WITH CONTROL APPARATUS

The engineer who is alert can retain control of this locomotive by responding properly to signals. If he does not respond to a "stop" or "slow" warning of the block signal system, his train stops. A "clear" signal necessitates no action on his part. Note location of reset

Is The Engineer Alert?

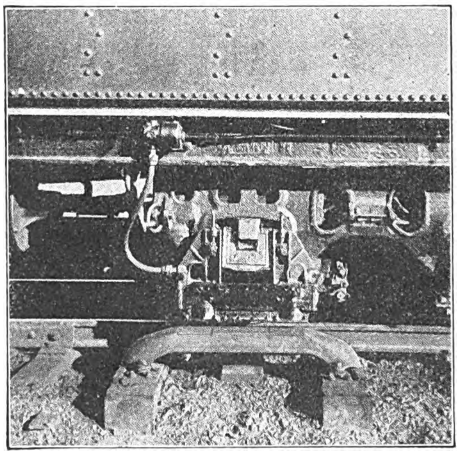
Train Control Apparatus Stops Train Automatically if for Any Reason the Engineer Fails to Respond to Signals

ALTHOUGH our railroads are running with an ever-increasing factor of safety due to greater operating efficiency in many respects, we hear from time to time of a railroad accident, the cause of which is laid to failure of the engineer to respond to signals and control his train properly. Practically all railroads of any consequence in this country are equipped with automatic block signal systems which, besides allowing speedier and more efficient service, serve to promote safety to a degree that might be perfect were it not for the fact that the human element still enters into the question. The possibility, remote though it may be, of an engineer failing to control his train due to mental aberration, illness, or sudden death has focused attention for many years on the vital question of automatic control of trains.

THE first attempts to devise a method of controlling train movements through the medium of wayside apparatus can be traced as far back as 1859. But all the elements required for such control were lacking until the invention of the air-brake in 1869 and of the closed circuit for block signals about a year later. Even then, years of laborious evolution for both these devices were required before train control became practicable.

In addition to hosts of amateur and independent inventors, a number of railroads devoted a great deal of energy and considerable sums of money to attempts to find and develop a successful automatic train control device. Conspicuous among these was the New York Central Railroad, which appointed a committee in 1904 to study and experiment with automatic train control. This was two years before Congress took cognizance of the subject by legislative action and 18 years before the will of Congress was formulated in a specific order by the Interstate Commerce Commission to make the first installations. Not until then had ideas on automatic train control crystallized sufficiently even to hold out a hope of success.

The committee, in the course of its work, found that not less than 3600 patents had been issued for train control devices. It painstakingly examined these and found nine devices that seemed worthy of trial. These nine were tested exhaustively in actual operation, but it was determined that none of them had been developed sufficiently to warrant adoption. Finally, after further experiments and development work the committee decided that the device best suited for the conditions prevailing on the New York Central lines was the General Railway Signal Company's intermittent, inductive, automanual type automatic train control, which superimposes upon the fixed signal system already in operation a rolling signal system which offers additional safeguards. This rolling signal system is now in use on the main line of the New York Central between Croton-on-Hudson, New York, and Englewood, on the outskirts of Chicago, the longest stretch of main line so protected in the United States, if not in the world. Large stretches of main line track on other New York Central lines likewise are protected by train control.



RECEIVER AND INDUCTOR

Intermittent inductive train stop receiver on tender journal; inductor is on the ties

THE object to be attained by train control is to enforce obedience of the automatic block signals with which the lines have long been equipped. The train control is connected with the block signal system and is a part of it, so that there is no chance for disagreement between wayside signals and train control regarding whether a train should stop or proceed.

If the engineer fails to observe and obey the block signals, the train control apparatus brings the train to a stop. It cannot proceed until some one steps down from the engine to the ground and moves a lever which allows the brakes to be released.

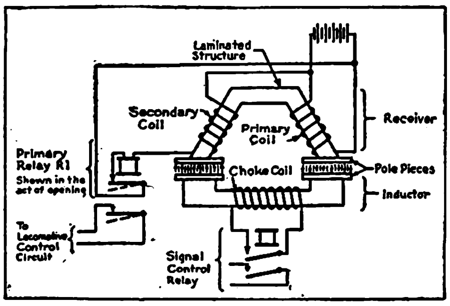
Apparatus by which this is accomplished is in two parts: one on the locomotive, the other attached to the track in the rear of the automatic block signal with which it operates.

THE part attached to the locomotive, designated as the "receiver," is attached to a journal box on the tender. It consists of an inverted U-shaped magnet with laminated cores, large pole pieces, and two coils. The primary coil of the receiver is constantly energized from the turbo-generator which supplies current for the headlight and cab lights on the engine, producing a strong magnetic field. The secondary coil is connected with the same circuit and also with a relay through which a small current flows normally.

THE RESET CONTACTOR

When the train has been stopped by the automatic apparatus, this must be reset

The track element, which is called an "inductor," is similar to that on the locomotive. It is attached to special cross-ties with its pole face two and one half inches above the top of the rail and its inner vertical face about 17 inches from the rail. It is protected by a non-magnetic housing. The inductors have a choke coil automatically controlled so that while the signal with which it is connected is at clear, the coil is closed on itself. When the receiver on a passing locomotive approaches an inductor having an open circuit—that is when the signal indicates "caution"—a magnetic flux builds up in the secondary coil producing a current in the receiver which causes the relay to open and apply the brakes through an electro-pneumatic device attached to the engineman's brake valve. Once the relay opens, the engineer cannot prevent his train from stopping and cannot reset the device until he can reach the reset button on the rear of the tender. This he must do from the ground.

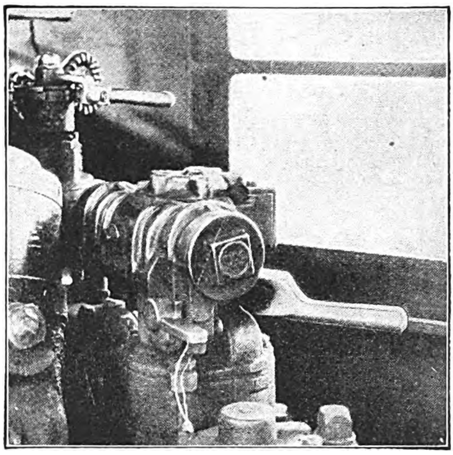


HOW IT WORKS

Wiring diagram illustrating the principle of the control system described in the text

The primary purpose of automatic train control is to compel obedience to the automatic signals. The engineer, when approaching a signal which indicates that he must stop or slow up, will acknowledge the signal by operating a "forestalling" lever which is located in the cab. He holds this lever down until an acknowledging whistle informs him that the inductor has been passed. If this lever were held longer than 15 seconds, the brakes would be applied automatically. The underlying principle is that by his acknowledgment the engineman has shown that he is alert and in full control of his train.

So long as the road is clear for two blocks ahead of a moving train the semaphore blades of the block signals point toward the zenith, or a green light is displayed. This indicates to the engineman that he is expected to proceed at the proper speed.



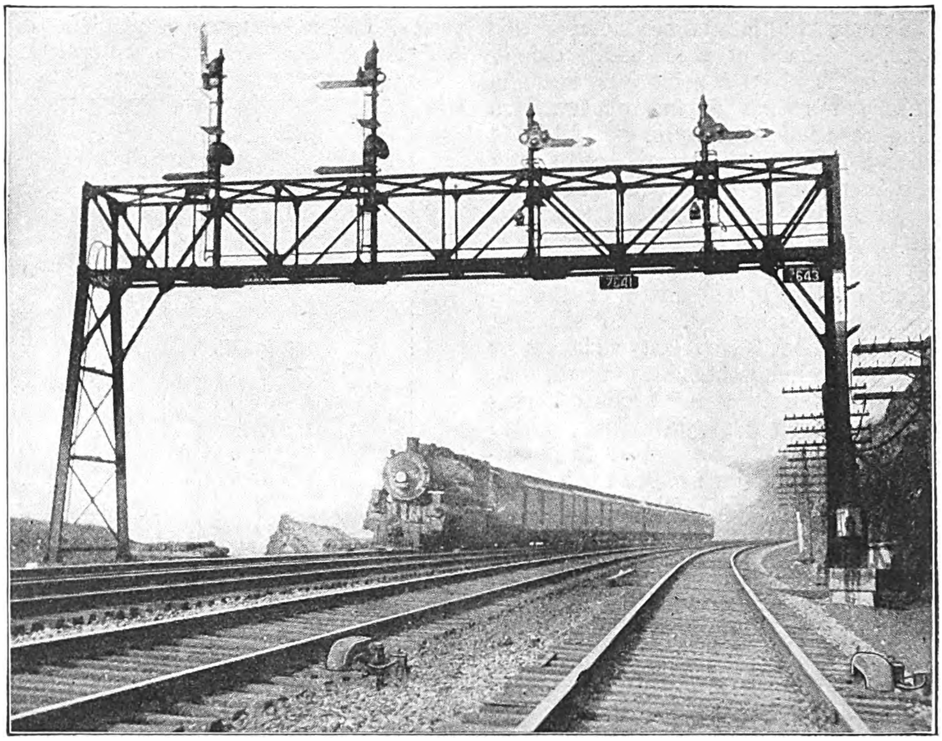
BRAKE ACTUATOR

Attached to the cab brake valve, this device is controlled electro-pneumatically

But if the semaphore blade is at an angle of 45 degrees, or if a yellow light is displayed, it is a warning to reduce speed so as to be able to stop just before reaching the next signal unless it changes to yellow or green as the locomotive approaches, in which case the train proceeds.

In other words the New York Central main lines will not be mechanically operated. Its trains will continue to be run by experienced men whose vigilance will be supplemented by a marvelous apparatus, ever ready to act in an emergency, if for any reason, the engineman should be unable to perform his duties.

Several other railroads in the United States installed similar train control systems before the original order of the Interstate Commerce Commission made it compulsory. These and other roads are rapidly extending their train control systems.



FOUR TRACK MAIN LINE SHOWING INDUCTORS

Semaphores on the two right hand tracks show "stop." If the engineer does not hold his forestaller lever as he approaches, his brakes will be set automatically and his train will stop

Solar Research for Amateurs—II

How to Construct the Spectrohelioscope, Which Reveals Solar Phenomena In Actual Motion

By GEORGE ELLERY HALE, Sc.D.
Honorary Director, Mount Wilson Observatory of the Carnegie Institution

(Concluded from April)

AS explained in the last article, some of the most spectacular and beautiful phenomena in the heavens are visible daily in the solar atmosphere. These have so recently become accessible to visual observation that they are but little known, and thus offer promising opportunities for discovery to amateur astronomers. The purpose of this article is to explain the construction of the simple instruments necessary to observe them.

The telescope required is of the coelostat type, giving a fixed solar image two inches in diameter for study with a spectrohelioscope.

The coelostat consists of a plane mirror of plate glass, five and one half inches in diameter and one half inch thick, mounted with its surface parallel to the Earth's axis and uniformly rotated by an ordinary (two dollar) clock movement at the rate of one complete revolution in 48 hours. The front surfaces of the coelostat and second mirrors should be plane to about one quarter of a wavelength.

A COELOSTAT (in which the plane of the mirror is parallel to the polar axis) is recommended in this article, instead of a heliostat, chiefly because it gives a solar image which does not rotate during observation. The rotation of the image obtained with a heliostat is slow, however, and the only difficulty it involves in visual observations is the necessity of redetermining the orientation from time to time, in case the heliographic positions of the prominences or flocculi are to be recorded. The simplest possible substitute for a coelostat or two-mirror heliostat is a polar heliostat, which is merely a polar axis carrying within a fork a single mirror, which sends the sunlight upward or downward through a lens toward the north or south pole. In this case (unless a second mirror is used) the spectrohelioscope must be mounted in a plane parallel to the Earth's axis.

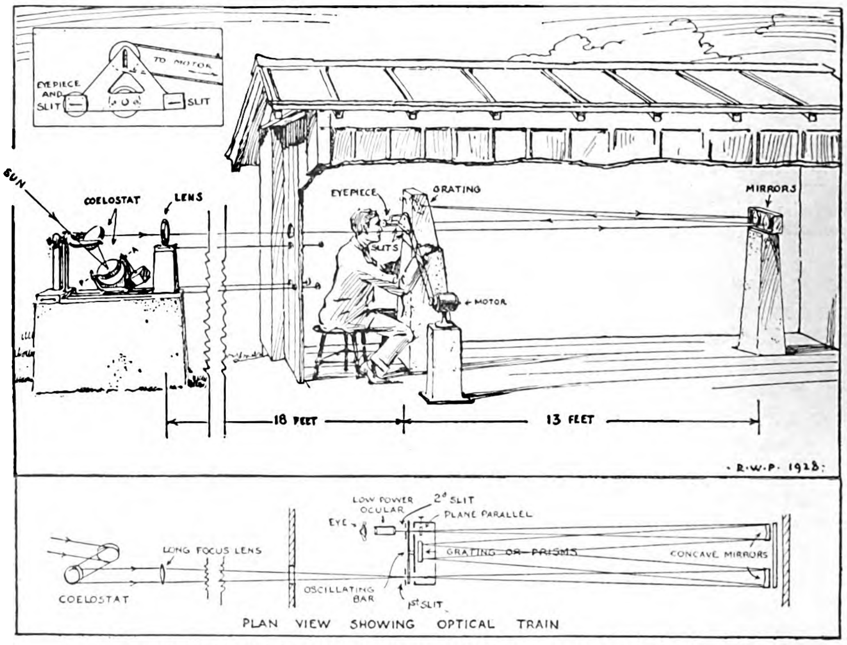
The parallel rays of sunlight reflected from the silvered front surface of the coelostat mirror fall on a second mirror of plate glass, four and one half inches in diameter and one half inch thick, mounted in a fork, and provided with slow-motion screws controlled by the observer with rods or cords. This mirror is fixed during observation, but the slow motions permit the observer to move it sufficiently to bring any point on the Sun's disk or circumference to the center of the slit of the spectrohelioscope.

These two mirrors, of course, do not form an image of the Sun. They serve merely to send the parallel rays in a chosen direction (usually north) and to hold them there during observation. The solar image is formed by a single plano-convex lens three or four inches in diameter and of 18 feet focal length, mounted on a support which can be moved north or south with a coarse screw by the observer for focusing the image on the slit. Such a lens is suitable only for observations with monochromatic light. An achromatic lens is needed for direct observations of sun-spots in white light. A small telescope having an achromatic lens one or two inches in diameter, with eyepiece permitting a solar image from four to six inches in diameter to be projected upon a white card for recording the positions of sun-spots, will serve as a useful auxiliary. The larger spots can be fairly well seen, however, on the two-inch image given by the single lens, especially if it is looked at on a white card through dark spectacles, supplemented by a piece of red glass to eliminate other colors.

The coelostat, second mirror, and lens are shown on page 437, mounted on a wooden tripod south of a small garage containing the spectrohelioscope. For permanent use a brick or concrete pier, covered with a small wooden house easily removable when observations are to be made, should be erected as a more stable base. The coelostat may stand either east or west of the second mirror support (out of its shadow), but on account of the varying altitude of the Sun, it must be moved north or south and fixed for any given date at a point where the reflected beam falls on the center of the second mirror. The beam is then maintained in place by the driving clock.

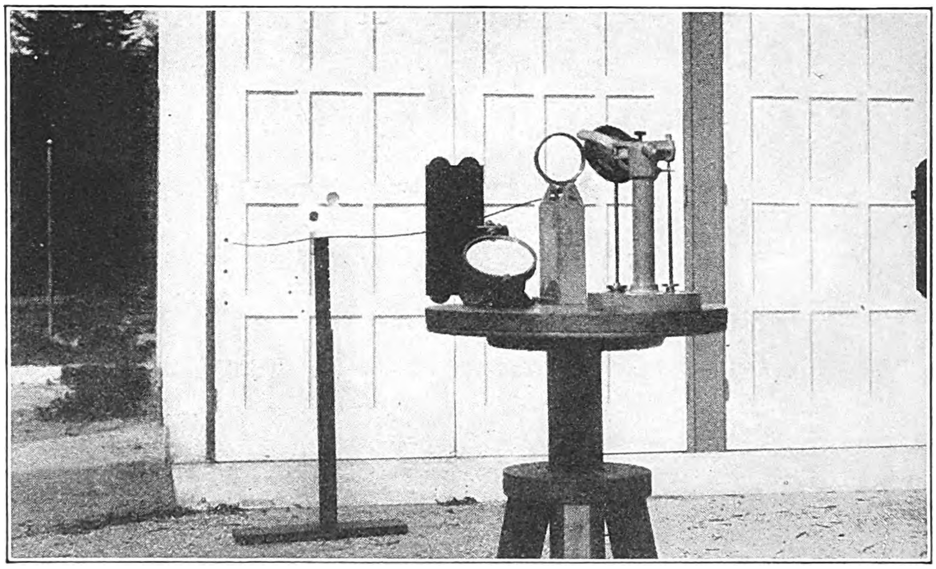
THE spectrohelioscope is merely a long-focus spectroscope, provided with a pair of rapidly oscillating slits affording a view of a portion of the Sun's atmosphere in the monochromatic light of the red hydrogen line known as $H\alpha$. It gives such an image of the Sun as might be obtained through a red screen (if such could be made), transmitting no light except that due to this hydrogen line.

An ordinary spectroscope consists of a narrow slit, a (collimating)lens for making the divergent rays from the slit parallel, a grating (or one or more prisms), and a second lens for forming



SOLAR TELESCOPE AND SPECTROHELIOSCOPE

This shows clearly the path of the rays used in forming a red ($H\alpha$) hydrogen image of a part of the solar atmosphere. From a special drawing by Russell W. Porter



SMALL SOLAR TELESCOPE USED

The coelostat mirror at the left, driven by clockwork, reflects the sunlight to the second mirror which is provided with slow-motion screws for directing the solar image. This is formed by the simple lens or collimator (center), adjustable by a screw for focusing the image on the slit of the spectroheliosccope 18 feet away, within the building. Note small opening

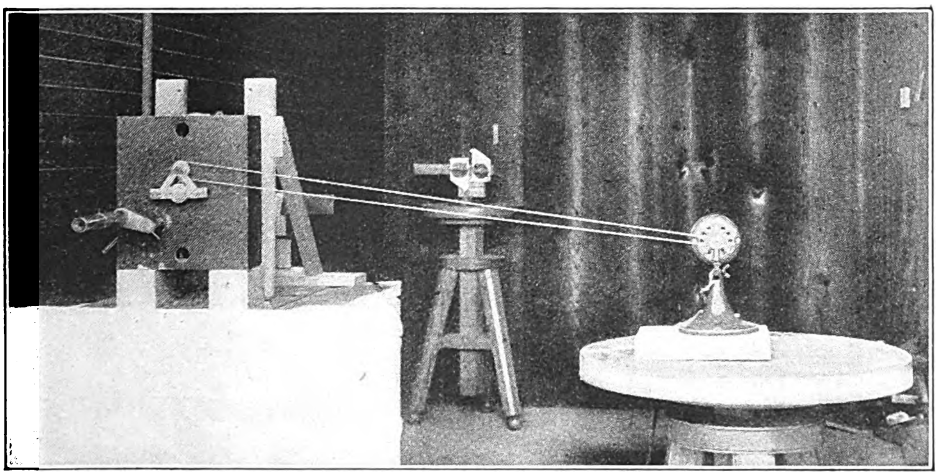
an image of the spectrum, which is examined by the observer with an eyepiece. The grating is a plane surface of polished speculum metal, on which about 15,000 lines per inch are ruled with a diamond. This diffracts the incident light, and produces a number of spectra resembling those given by prisms.

In the present instrument two spherical concave mirrors, of two inches aperture and 13 feet focal length, mounted upon a single support permitting them to be focused by a screw, are used in place of lenses. Light from the solar image falls upon the collimating mirror 13 feet away, and is returned (by a slight inclination of the mirror) to the grating or prisms mounted behind and above the slits. The red (H*α*) region of the spectrum thus formed, falling upon the second concave mirror, is reflected to a sharp focus at a point near the first slit. Here it falls upon a second slit, adjusted so as to coincide with the center of the H*α* line.

THE operation of the instrument will now be evident. If the first slit, on which the solar image is focused, is moved in the plane of dispersion, the spectrum will move a corresponding distance. To remain on the line, the second slit must be displaced accordingly. The first and second slits are therefore carried at the opposite ends of a very light metallic bar, mounted on a bearing halfway between them. This bar is oscillated rapidly by a small electric motor, through an amplitude (usually about a quarter of an inch) which is limited by the brightness of the spectrum. The observer, looking through the oscillating second slit, which remains exactly on the H*α* line, sees by persistence of vision a hydrogen image of a portion of the Sun. This may include a part of the limb, where a prominence appears bright against the sky, and at the same time a part of the disk, upon which a portion of the same prominence may extend as a dark flocculus.

High velocities in the line of sight produce distortions of the H*α* line, toward the violet when the gas is approaching, toward the red when it is receding. To see a mass of hydrogen receding at a velocity of, say, sixty kilometers a second the second slit must be set, not on the normal position of the H*α* line, but at a position completely outside of it toward the red. A simple "line-shifter" is employed for this purpose. A graduated arc indicates the displacement of the line from the zero position, and thus gives the radial velocity of the portion of the flocculus under observation.

In the above design the slits are only 3½ inches apart. They are therefore mounted horizontally, so as to permit direct observation through the second slit by the right eye without obstruction of the solar image on the first slit by the observer's head. The bar that carries them, like the slits themselves, is extremely light and stiff. An upward extension of this bar is pierced by a fiber-lined vertical groove, in which a steel pin, fixed eccentrically in the head of a horizontal shaft, serves as the driving device. A small electric motor, belted to a pulley on this shaft, causes the slits to make thirty or forty single oscillations per second. The amplitude is about a quarter of an inch or less, and the motion is smooth and quiet, although there is a slight flicker unless a higher speed is used, which is likely to cause vibration of the grating, unless this is very firmly mounted on an independent support. However, a little flicker does no harm, and is soon forgotten by the observer.



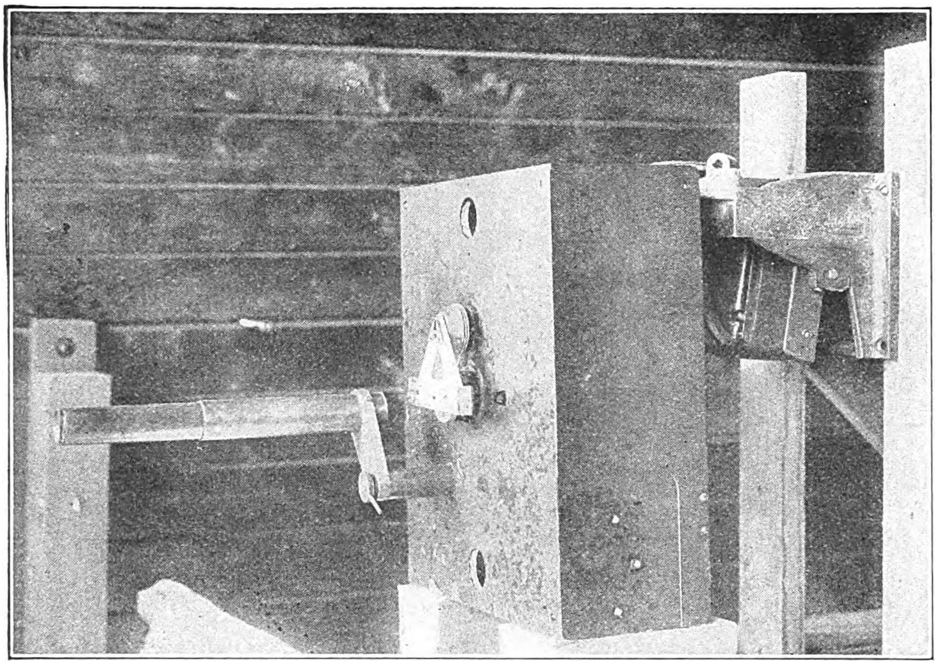
SIMPLEST FORM OF SPECTROHELIOSCOPE

Sunlight passing through the first slit (right) falls on the collimating mirror, which returns a parallel beam to the grating mounted above the slits, behind the casting. An image of the H*α* line of hydrogen in the first-order spectrum, is formed by the left concave mirror on the second slit. When the slits are rapidly oscillated by the motor, a portion of the solar atmosphere is seen in hydrogen light through the eyepiece on the left (here turned aside to show the second slit). The entire apparatus may now be had ready made

THE second slit is viewed through a positive eyepiece magnifying from two to four diameters. The line-shifter, a strip of plane parallel glass, is mounted behind the second slit on a short shaft, provided with a large milled head for easy rotation by the observer and a divided arc showing the displacement in Angstroms or the equivalent radial velocity. An important adjunct is a screen to prevent the diffuse light of the collimating mirror from reaching the eye of the observer.

Similar protection against the glare of the bright solar image on the first slit should be provided, and a tube large enough to prevent reflections from its inner walls should extend from the slit to the opening through which the sunlight enters the building. In fact, the observing room should be as dark as possible.

I have found by experiment that with slits 0.004 inch wide, oscillating with an amplitude of 3/16 inch, the



OSCILLATING SLITS, EYEPIECE, GRATING HOLDER

These parts are shown mounted on temporary wooden supports. The eyepiece is pivoted and may be swung out of the way. The amateur may himself construct much of the apparatus

bright and dark hydrogen flocculi can be well seen on the Sun's disk when the grating aperture is reduced to $1\frac{3}{16}$ by 2 inches. A larger grating naturally gives a brighter image, in which more detail can be seen, but the above will serve for most classes of work.

Suitable gratings, even of the smaller size just mentioned as a minimum, may not be obtainable. I have therefore tried a less expensive arrangement, which may be adopted by amateurs who wish to build their own instrument and are content (until a good grating or reflecting replica can be obtained) to see only the more conspicuous phenomena. This is a pair of 60° prisms, which should be of very dense flint, and may be only just large enough to transmit a beam one inch in diameter, although a somewhat larger aperture is preferable. The dispersion of two ordinary flint prisms (here made quivalent to four by the use of a small plane mirror, which returns the light through the prisms to the second concave mirror) is less in the red than that of the first order of a (15,000) grating, and their performance is much inferior to that of a good grating; but with suitable slit widths they will show the stronger bright and dark flocculi, as well as the prominences at the limb. If, as I greatly hope, a satisfactory method of producing cheap reflecting grating replicas of excellent definition can be found, these may ultimately become available in place of original gratings or prisms.

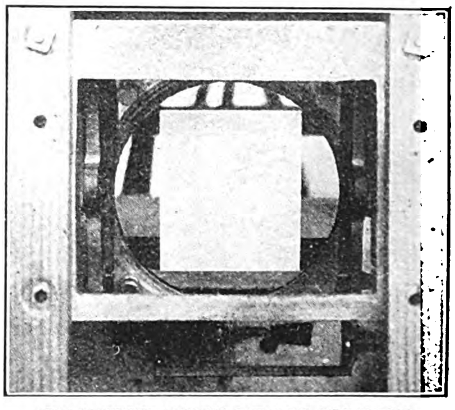
A BETTER design for oscillating slits has recently been developed by my instrument maker, Mr. Hitchcock. In this form the slits are vertical and farther apart, and the driving mechanism is improved.

As in the case of the spectroheliograph, a monochromatic image can be produced either by motion of narrow slits with respect to the solar image, or by motion of the solar image with respect to the slits. The chief difference between the two instruments lies in the fact that the spectroheliograph builds up its image gradually, slit-width by slit-width, by a slow motion of the slits or of the solar image with respect to the photographic plate, while the spectrohelioscope must reveal a considerable area of the image at once to the eye, which obviously could not see the forms of the flocculi through slowly moving slits a few thousandths of an inch wide. Hence the rapid motion of the slits or of the solar image required for the spectrohelioscope.

I have tried successfully oscillating bars carrying from one to five slits at each end and a rotating disk carrying fifty radial slits. The most effective means I have tested of producing rapid motion of a portion of the solar image with respect to fixed slits is a square prism of glass mounted before each of the slits, rotating uniformly about an axis parallel to them. The portion of the solar image under observation reaches the first slit through one prism, while the resulting fixed monochromatic image is seen in an eyepiece focused through the other prism on the second slit. This ingenious device is due to Dr. J. A. Anderson. It is somewhat more expensive than the oscillating slits, and seems to show no details of the flocculi not visible with them. However, the elegance of this method, and the complete freedom from vibration and flicker which it affords, make it an attractive alternative for oscillating slits. It can be readily attached to any Littrow spectroscope of suitable dispersion, but I have found this type of spectroscope (in which a single lens serves for both collimator and telescope) much less satisfactory for the purposes of the spectrohelioscope than the two-mirror form illustrated, because of the impossibility of excluding from the eye the light due to the illumination of the collimating lens and the grating behind it by the sunlight from the first slit. The reflected light can be excluded by using a suitable lens for the collimator, but the remaining diffuse light, superposed upon the Hα line, materially reduces the contrast of the flocculi, even when a suitable red glass is placed over the eyepiece.

THE spectrohelioscope shown in the illustrations was built from various parts that happened to be available, and does not represent the final design. The working drawings show a more compact support for the two concave mirrors, and various other improvements. Blueprints of these drawings, detailing all the parts of the various instruments mentioned in this paper, may be obtained at low cost by writing to the Mount Wilson Observatory, Pasadena, California. It should be stated whether blueprints are wanted of (A) the least expensive form of spectrohelioscope (shown in the drawing on page 436); a more expensive form (B), with vertical adjustable slits and improved oscillating bar; or a similar design (C), provided with Anderson's rotating prisms.

In the space here available I have been unable to give many important details regarding the construction, adjustment, and use of the instruments. I hope to describe these partly in the *Publications of the Astronomical Society of the Pacific* and more completely in a small book on solar research for amateurs. Let me add that all those interested should read such books as Lockyer's "Contributions to Solar Physics," Young's "The Sun," and Abbot's "The Sun." I have referred briefly to some of the early work of Lockyer in an article called "Exploring the Solar Atmosphere," published in *Scribner's Magazine* for July, 1928.



GRATING SEEN FROM NORTH

It shows above the windows in the casting corresponding to the two slits

The Three Best Light Planes

Besides a Cash Award, a Gold Medal Will Be Given for the Best Design. Medals Also for Two Next Best

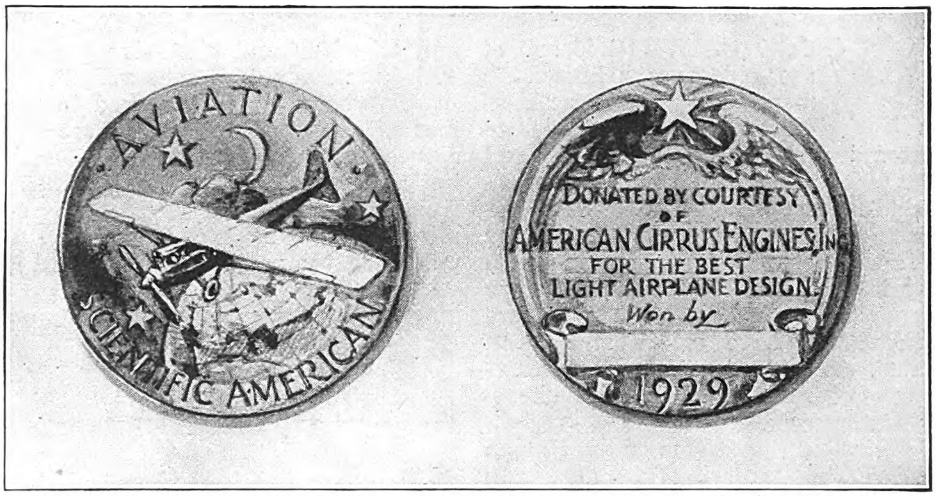
OUR Light Plane Design Competition, the main details of which were given in our April issue and which takes on an added interest because of supplemental awards to be described below, is of particular significance due to the close connection SCIENTIFIC AMERICAN has maintained with aviation since its inception. In the early years, when the science of flight in heavier-than-air machines was fighting to gain public confidence, SCIENTIFIC AMERICAN took the lead in sponsoring its progress and, since then, has accorded it much support. Thus, when all the world is looking forward to the early adoption of small light planes for private use, the present competition is especially timely.

THE CURTISS TROPHY

Won by Glenn H. Curtiss, this was the first given in aviation by any magazine

Over 20 years ago, on July 4, 1908, Glenn H. Curtiss won the first leg of the first prize ever to be offered by any magazine for a specifically announced flight—the SCIENTIFIC AMERICAN trophy—by a sustained flight in the *June Bug* at Hammondsport, New York. The cup became the property of Mr. Curtiss when he made his famous flight from New York to Albany in 1910.

As the interest in aeronautics shifted from speed to utility several years after the war, SCIENTIFIC AMERICAN offered, in 1925, a cup for the best utility plane. This was won by a Powell airplane, a tiny machine equipped with a two-cylinder air-cooled engine of 16.7 horsepower. Piloted by "Jerry" Dack in the 1925 National Air Races, it averaged a speed of 76.41 miles an hour.



OUR GOLD MEDAL FOR THE BEST LIGHT PLANE DESIGN

Through the generosity of Colonel R. Potter Campbell, SCIENTIFIC AMERICAN offers this medal with 500 dollars for the best light plane design; also a silver and a bronze medal

For the best design of a light sport plane, SCIENTIFIC AMERICAN next offered a bronze plaque trophy. This was won at the National Air Races of 1926 by a plane designed by F. E. Seiler of the Kreider-Reisner Aircraft Company, Hagerstown, Maryland. Weight of this plane, fully loaded, was 490 pounds. Piloted by A. H. Kreider, it averaged 94.5 miles an hour and made 99.4 miles an hour on one lap.

SCIENTIFIC AMERICAN TROPHY

UTILITY PLANE CUP

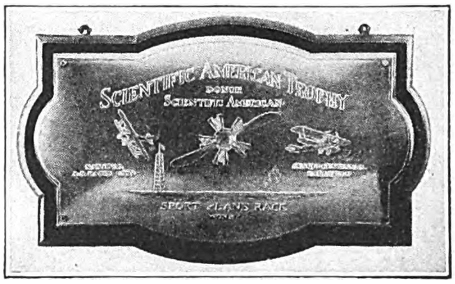
This cup, given by us in 1925, was won by a Powell plane with a low power engine

Thus it was but another step in the sequence to offer an award for a two-seater airplane design to be built around the Cirrus Mark III engine.

We are happy to announce that, in addition to the 500 dollar cash award already detailed in full, Colonel R. Potter Campbell also offers an attractive gold medal for the winner, as well as a silver and a bronze medal for the second and third best designs, respectively.

The committee has added to its numbers, as was originally intended, two men well-known to aviation enthusiasts. The membership to date is as follows: Miss Amelia Earhart, Professor Alexander Klemin, Mr. George Palmer Putnam, and the two new members: Colonel V. E. Clark of Buffalo, New York, and Mr. Reed G. Landis, president of Reed G. Landis Company, Chicago.

All who desire to enter this competition, which closes August 15, 1929, should write for an entry blank to: Committee, Light Plane Design Competition, care of SCIENTIFIC AMERICAN, 24 West 40th Street, New York, N. Y.



SPORT PLANE PLAQUE

A tiny plane weighing 490 pounds, fully loaded, won this award at the 1926 races

Mechanical Etching in Wood

Decorative Woodwork Etched with Modern Mechanical Equipment Rivals the Hand-Carved Creations of Old World Artisans

By LAWRENCE WM. PEDROSE

WOOD CARVING is one of the oldest arts known to man, and by it archeologists are often able to determine the degree of culture and the plane of civilization of the world's primitive peoples. The ancient Egyptians made extensive use of wood for interior decoration, carving and painting it with pictures to commemorate important events. The Romans are believed to have created the wood panel, probably to relieve the sternness of marble and stone in ornamenting their dwellings.

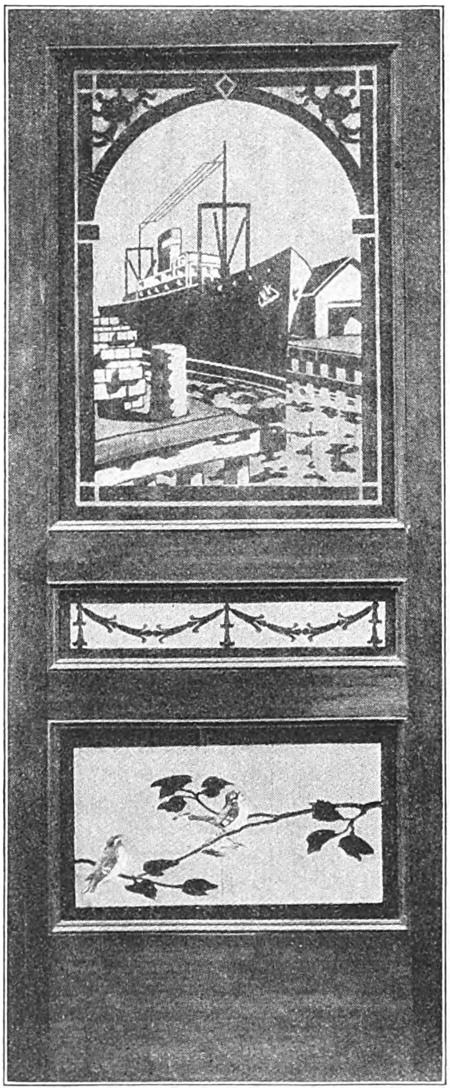
Following the decline of the Roman empire, wood carving languished, to be revived in Italy during the Renaissance. England's early day baronial halls revealed examples of carved wood paneling rivaling those of Italy, and colonial America received much of its inspiration from England.

The wood panel gradually lost in popularity upon the advent of wall paper, which in its infancy copied the designs and tones of the wainscot and panel. Paper was cheap and it brought to the modest home the artistry previously available only to the wealthy. Later, wall paper developed into a medium for bringing bright colors into the home and the wainscot and panel ideas were lost.

Recently, however, methods have been discovered for producing carved wood panels mechanically, and the dignity expressed by woodwork in the early English country houses, and the paneled charm of venerable Italian villas, can now be reproduced at comparatively small expense.

BRINGING decorative woodwork within reach of the average purse has been accomplished through adaptation of old processes and application of the science of a mechanical era. Perhaps the most outstanding of these processes is the sand blast and stencil method, which has long been used in the manufacture of glass. While cutting a design in a glass window, an artisan accidentally turned the sand blast upon an exposed side of a soft board. The sand ate away the softer grain and left the hard grain standing out in relief. This chance discovery was methodically developed into a well defined practice. Before long it was realized that decorative effects similar to those obtained in rare hand-carved panels could be produced mechanically by etching with sand, and laborious and expensive carving with knives could be done away with.

The woods principally used in the mechanical etching process are fir, spruce, hemlock, cedar, and redwood, but any soft wood that has a distinctive grain may be utilized. A fiber or metal stencil is made of the design and placed on the wooden panel. Sand is then applied under pressure and the soft wood between the harder grains is eaten away, producing a relief effect that is very pleasing to the eye. The annual rings in the tree from which the lumber has been cut provide the essential grain. The wood marking the tree's spring growth is soft, while that grown in the summer is almost impervious to wear. The board may be either of vertical or flat grain, and each produces a novel effect.



DECORATIVE PANELS

Sand-blast etchings in plywood door panels with effects accentuated in colors

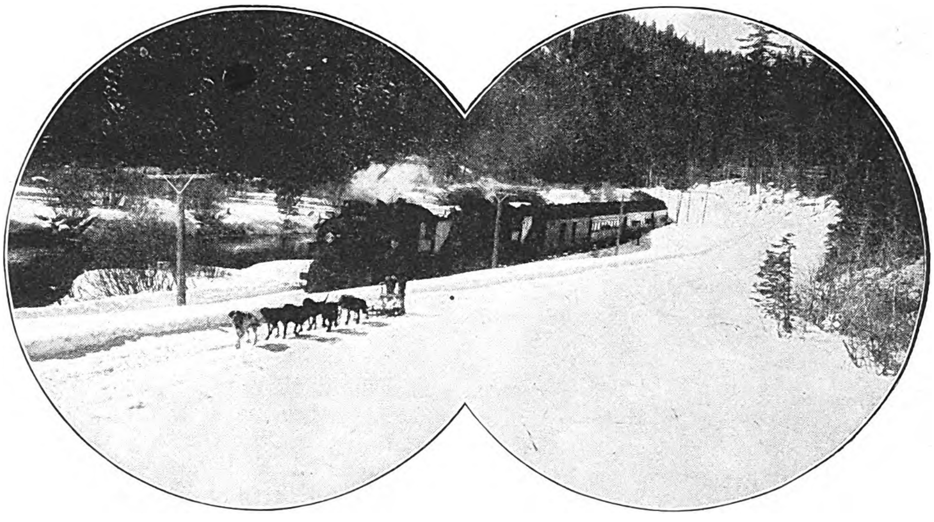
Any design or picture that can be stenciled with paint can be reproduced by the sand etching process. Fine lines, intricate patterns, or boldly outlined masses are produced equally well by the cutting action of the flying sand. After the etching is completed, stains may be used to bring out the high lights or accentuate any part of the design. In a variation from the sand-blast method, revolving steel brushes may be used to gouge out the soft wood, but while this process is cleaner in that shavings and not dust result, the sand blast is simpler and permits wider application.

SAND etching is by no means difficult and lends itself easily to amateur experimentation. Stencils are made the same as for painting. The sand blasting can be done at a commercial glass or metal works where equipment of this type is regularly used. Although the commonly known fir, spruce, hemlock, and soft cedars are best adapted for sand-blasting decorative designs, it has been found that almost any soft wood that has a distinctive grain will yield very satisfactory results if reasonable care is taken in etching. Douglas fir plyboard can be obtained at any large retail lumber plant. The number of designs that can be worked out are almost limitless and depend only on the ingenuity and artistic ideas of the experimenter. If colors are desired to produce effects other than those of the natural woods, ordinary inexpensive stains are used with unique and interesting results.

A notable example of mechanical etching is to be seen at the nation's capitol, in the so-called "Wooden Room" of the Pan-American building at Washington, D. C. This room was finished in Douglas fir, a commonly known wood, and unusual designs were worked out to emphasize the quality and attractiveness of native American woods for interior decoration. Recently a large, modern hotel was constructed on the Pacific Coast with all interiors in decorative wood paneling etched by the new process. The luxurious finish of the woodwork in the salons and cabins of the new French steamship *Ile de France* furnish another up-to-date version of Old World artistry expressed in wood.

FRED PRINTZ—WINNER

Printz' time for the three laps totaling 96 miles was 8 hours, 39 minutes, 17 seconds



COURSE PARALLELED RAILROAD

The Sierra Dog Classic was run off on a course that was located parallel to the tracks of the Southern Pacific Railroad. Special observation trains were run for spectators and camera men

Dog Teams Race in California

CALIFORNIA, land of sunshine and orange blossoms, has taken unto itself a new sport. And this sport is nothing more or less incongruous with the average person's idea of California than racing with sleds and dog teams after the manner of the far north. A Sierra Dog Derby was recently run under the auspices of the Sierra Dog Derby Association, which is sponsoring winter sports in northern California and Nevada.

Staged only a few hours ride from the orange groves and the almond blossoms of the Pacific Slope, this innovation is bringing sled teams to the Lake Tahoe regions from all parts of the country. The races are not of the endurance type familiar to the more northern regions of this continent, but are of sufficient length to enable the teams and drivers to demonstrate their stamina, speed, and generalship, and to make possible split-second finishes that are thrilling alike to spectators and contestants. They are run in three laps over a course of 32 miles, extending from Truckee, on the old Overland Trail to Tahoe, on Lake Tahoe, and paralleling the tracks of the Southern Pacific railroad.

MRS. GEELAN

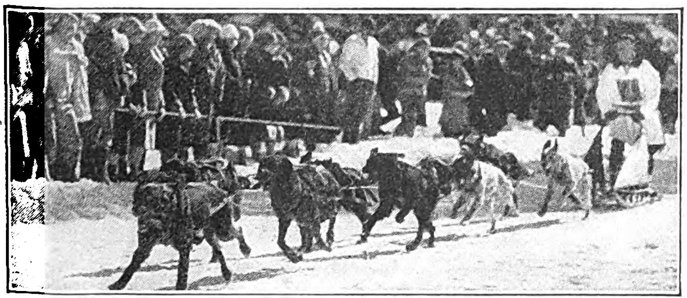
This 24-year-old bride battled bravely, but finished in fifth place

SCOTTY—AND SCOTTY

On the right, Scotty Allen, winner of second place. On the left, Scotty Malemute, Allen's lead dog

In the Derby run during last February, the total 96 miles were covered in 8 hours, 39 minutes, 17 seconds by Fred Printz, who won first place. Second came Scotty Allen, with his famous team of malemutes, who covered the course in 9 hours, 9 minutes, 18 seconds, just nosing out Roy Stover, who finished in 9 hours, 10 minutes, 42 seconds. Earl Kimball came in fourth in 9 hours, 13 minutes, 19 seconds, driving a team of red Irish setters. Mrs. Thula Geelan finished in fifth place, in 9 hours, 33 minutes, 19 seconds.

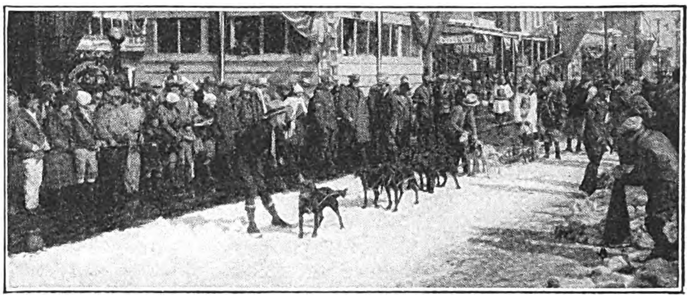
The Southern Pacific ran special observation trains over their tracks on the three days of the races to accomodate spectators and camera men. Excellent foresight on the part of those responsible for arrangements made possible easy handling of the crowds, and provided adequate arrangements for feeding them. California has undoubtedly established itself as a state for winter sports, as well as for continuous sunshine.



All photographs courtesy Southern Pacific Railroad

DOWN THE STRETCH

Fred Printz driving his team of Gordon and Irish setters along a smooth part of the course. Spectators gathered along the route



AT THE TAPE

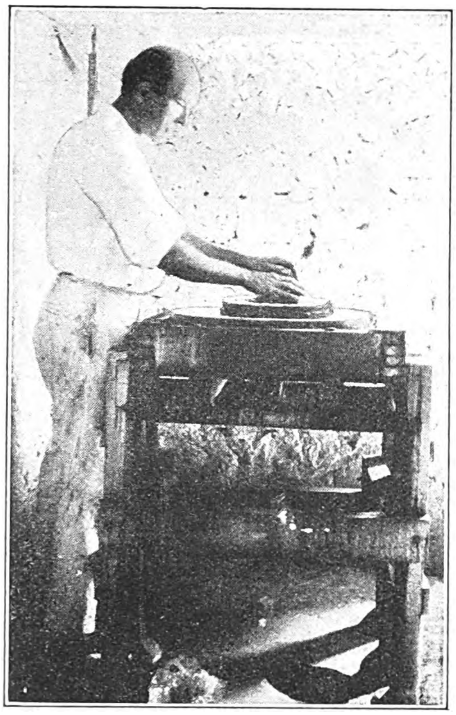
Roy Stover, who finished in third place, drove a team of seven Llweellyn setters. The dog team is shown here ready to start

Largest Amateur Telescope

How a Twenty-one Inch Mirror For a Home-made Reflector Was Completed by Hand

By GEORGE H. HAMILTON, M. A.

Member American Astronomical Society, Fellow of the Royal Astronomical Society



THE LONG GRIND

Grinding and polishing required over 1000 hours of work with eight-inch tool

IN the January, 1928, issue of the SCIENTIFIC AMERICAN mention was made that I was grinding a 21-inch disk for a Newtonian reflectory telescope to be used in Jamaica. This disk has at last been completed after 18 months of labor, and is mounted as a split-ring equatorial similar to the "Garden" telescopes designed by Russell W. Porter and suggested by Professor Pease for the mounting of a 25-foot reflector (SCIENTIFIC AMERICAN, September, 1926).

The split-ring and back bearing were connected by large, strong pipes with bolts running through them. This made of the assembly one complete piece, and the whole polar axis split-ring and back bearing was turned up as a single piece on the lathe. The vertex of the cone has an angle of 36 degrees, so the lower side of the cone when set up is parallel with the surface of the ground at this latitude, 18° N.

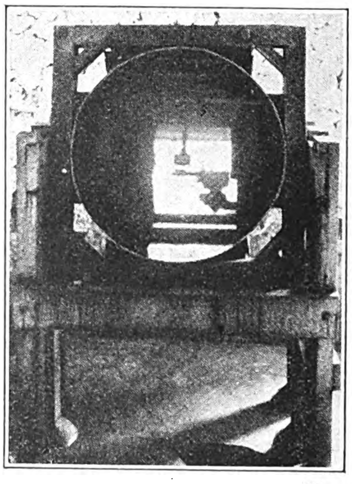
THE declination axis is supported by roller bearings and thrust ball-bearings in a single shell. The back bearing is also made up of a similar set of roller and thrust bearings. The two large bearings below the split-ring are ball bearings.

The complete instrument weighs approximately 1600 pounds; the largest solid iron weight over 600 pounds. The mounting was made to my design by the Kingston Industrial Works here in Jamaica.

To describe the performance of such a mounting it is best to show its defects from the first, be they inherent or due to faulty design. If I were to make another mounting, no matter what size, the ring itself would probably be made proportionately larger. This would allow the counterweights to be placed farther from the declination axis, and therefore they could be less cumbrous and of less weight. It would also allow the tube to be balanced easily, no matter what instruments were placed on the eye end. On the other hand, if the split-ring were made larger, the declination axis would be proportionately longer, introducing liability of flexure. The weights, being farther from the axis, might also flex. In the present mounting the whole telescope tube with the declination axis and weights is to all intents one solid block.

FLEXURE from the bending of the tube is reduced to a minimum, since the mirror rests upon the declination axis, and the tube bears only the negligible weight of the instruments at the eye end.

All heavy weights are close to the axis, therefore there is no vibration as the telescope moves. Inertia, which is easily overcome when necessary, keeps the telescope rigidly on the object observed without the trouble of clamping. When clamped rigidly, any vibration that may occur in the mounting becomes doubly evident, so I prefer what might be called a "finger adjustment" to all moving parts. This mounting can literally be moved with the little finger and the object will remain steady in the field of view.



TIPPED UP FOR TESTING

The slide rest of a lathe was used to hold lamp and knife-edge. Its reflection is visible

If I had listened to all that has been said about the difficulty of constructing a mirror over eight inches in diameter, this 21-inch mirror would hardly have been commenced. It was found at the start, when the rough casting as it came from the Saint-Gobain works in France was unpacked, that a 160-pound disk is no small block to handle with means such as are found in a country house at least 60 miles from the nearest machine shop.

The first requirement was a stand on which to place the mirror for work, and since I could not lift the glass for testing after every polish, the tray in which it rested had to be made to tilt almost vertically. Ford parts came to the rescue, a Ford rear axle serving as a pivot on which to turn the tray and mirror.

The most difficult part of the grinding was bringing the back of the mirror approximately even and parallel to the front. For this was used an eight-inch tool one inch thick. This, by the time the work was finished, was reduced to one eighth its original thickness.

For the face, a 12-inch tool that had served as the tool for my previous mirror was used. Both the rough and fine grinding were quite easy with a straight, over-center stroke. At first the tool was convex and this at once started a concavity in the big disk and prevented the turned edge which would have been likely to occur if I had used a full sized tool—the mirror, of course, being underneath and face up.

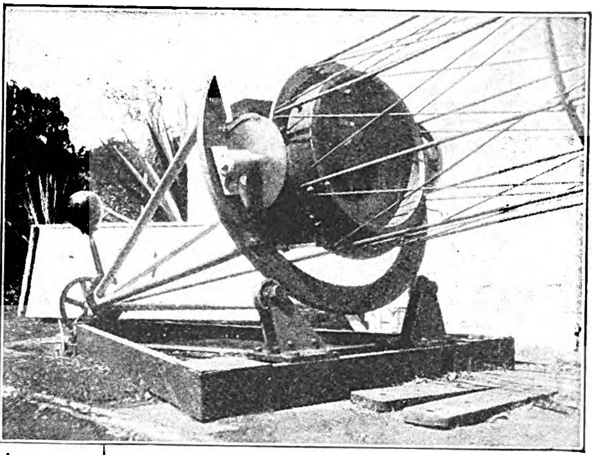
I made sure of the curvature at first by alternately grinding a new 12-inch disk and testing this 12-inch at its center of curvature by the ordinary wet surface method. As long as the tool remained in contact with both disks after a few strokes on each it was evident that the large disk was within bounds. This alternation was kept up through the first three grades of carborundum; so I now have a second 12-inch mirror very nearly in a condition for polishing.

THE pitch lap was made in the usual manner, except that the pitch was boiled to make it harder in this climate. Grooves were cut in it initially, but these soon filled up. It was then used as a plain surfaced lap right through the polishing of the mirror up to the final strokes, without change, the tiny, evenly spaced pits in it caused by the bubbles due to boiling the pitch acting very much like the depressions in the honey-comb foundation lap.

In using the 12-inch tool on the 21-inch disk, a straight over-center stroke caused a zone to form in the mirror six inches from the center. This was evidently the envelope of the trails formed by the edge of the tool as it traversed the disk. A chord stroke with center of tool half way between the center and edge of the mirror also made a shallow zone—in fact, anywhere off center the center of the tool seemed to grip more than the rest. The best stroke was an elliptical one of great eccentricity, nearly a straight stroke, in fact, but with the center of the tool about one and one half inches off center, and never lapping the edge of the tool over the edge of the mirror by more than the same amount. This stroke smoothed and corrected the whole surface of the mirror.

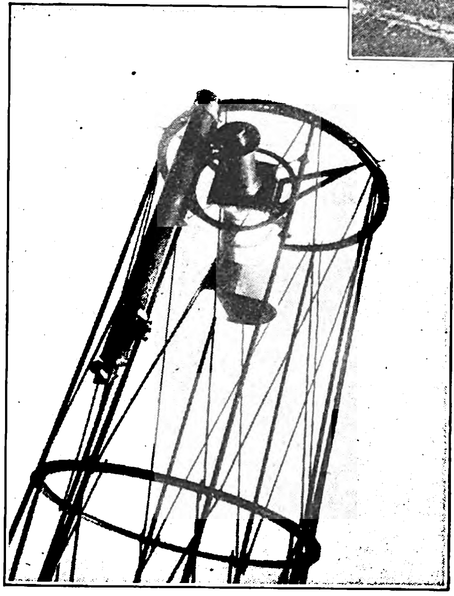
VERY little has been written on the correct amount of grip the tool should have on the mirror while polishing. When used in a thick paste, the rouge seemed to scratch, but when watered, the tool floated over the surface of the mirror with a consequent waste of rouge and no results. The mirror was finally covered with a medium mixture of rouge smoothed over the surface by a few strokes of the tool. This mixture would stiffen up slightly while cold pressing. The tool would then grip fairly well—the rouge under these circumstances turning from red to orange by an admixture of pitch or turpentine out of the lap. A book might be written on this subject alone.

In parabolizing, I used cardboard disks with one or two complete half-inch zones cut out. There were 15 of these in all. Since, owing to diffraction from the edges of the zones, the eyepieces can not focus well enough the images of the pinhole formed by these zones, I used the knife-edge to test the intensity and equality of the light, as explained in "Amateur Telescope Making" and in Ritchey's writings, comparing the dark streaks in the center of each zone at right and left. When bringing up the knife-edge, the bottom and top portions of the zones would naturally darken from the knife-edge outward if inside focus, and inwards toward the knife-edge if outside focus. One then had only to run the knife-edge quickly in and out to see a shadow pass backward and forward along the top and bottom of the zone. The quicker one did this the more marked it was; the only place where there was no such motion, but a uniform darkening, being at the focus. I found this even more accurate than comparing the left and right sectors for equal light intensity.



DETAIL OF MOUNTING

Bolts in the forward portion of the bottom frame and in its tail adjust the telescope with precision, for azimuth and altitude



THE EYEPIECE END

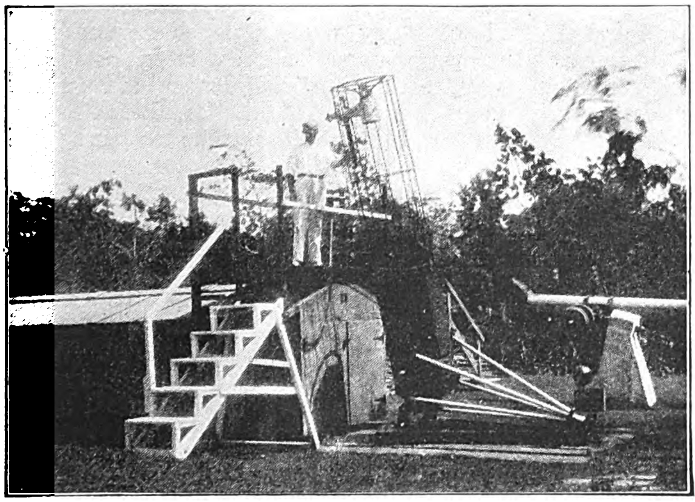
A temporary cardboard dew cap protects the diagonal flat, and seems to work perfectly. Note prism on the finder

My final plotted curve for $r^2/2R$, the modified formula used when the lamp moves with the knife-edge, showed that the greatest error, outside the central part which would be cut off by the flat, was no more than 0.008 of an inch. The focal length is 128 inches.

THE silvering was by the Brashear process and was a success the first time. For practice I first gave my 12-inch its second coat.

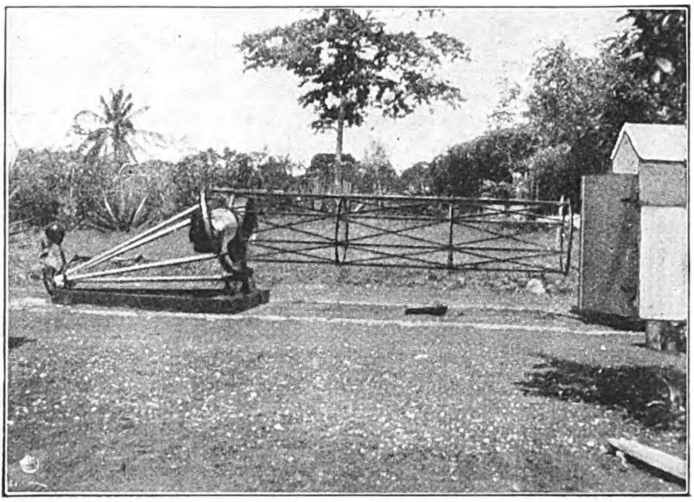
The whole mounting and mirror complete must have cost between 800 and 1000 dollars, not including my own labor and time. I was grinding and polishing for 18 solid months, with about half hour intervals for polishing and a test following each. I averaged at least three polishes a day. However, one would be able to do the job again in a much shorter time.

¶ *After initial experience gained on smaller mirrors, some amateur telescope makers are attempting larger sizes. One amateur tells, on page 464, how he made a 16-inch telescope.*



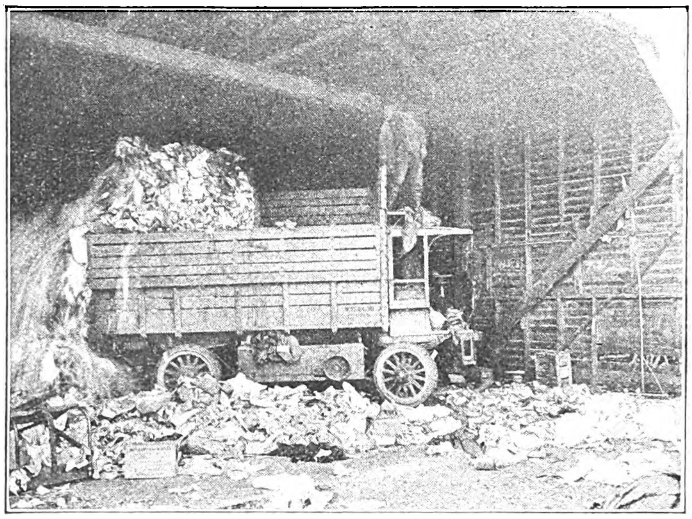
THE SHED AND OBSERVING STAND

The shed carries the observing stand on its top. A smaller telescope, described in the issue of January, 1928, also shows



HOW THE SHED IS USED

It is mounted on rollers and is rolled bodily over the entire telescope, after the tube has been lowered to a horizontal position



THE BEGINNING

The collected trash is loaded in trucks, in which are unloading nets. To unload, a cable pulls net and trash from the truck

THE INITIAL SORTING

Expert pickers are stationed along an endless conveyor which carries the trash. They remove all articles likely to be saleable

Rag-Picking as Big Business

In Washington, D. C., Household Refuse Is Collected by the Municipal Government and Much of it Is Reclaimed

By G. H. DACY

A STERLING example of the practice of business thrift and husbandry shines brightly in Washington, D. C., where the authorities supervise the work of reclaiming all but the soot from the 225,000 cubic yards of trash and refuse which the street cleaning department collects annually.

Baltimore and Pittsburgh, also, follow the Washington plan of "saving all of the hog except the squeal." These three cities devote several million dollars of municipal funds yearly to the collection of trash and refuse from the private homes of all householders within their corporation limits. Instead of hauling this million tons or more of rubbish to public dumping grounds and burning it, this trio of provident cities delivers the material at special reclamation plants. There all saleable stuff is segregated and sold, and the remainder destroyed in special incinerators.

Our national capital, a city of 100,000 homes and 500,000 residents, salvages more than 100,000 dollars in paper, tin cans, bottles, broken glass, and rags from the trash which it collects every twelve months. There is an appropriation for the daily removal of trash, refuse, ashes, garbage, and dead animals. Seventy five thousand tons of garbage are reduced to grease at a special plant owned by the District of Columbia and subsequently sold for 250,000 dollars. Collected trash is salvaged in a similarly profitable manner.

A huge electric press is employed to compress into bales millions of tin cans, which range in size from a face powder box to a large garbage can weighing 85 pounds. Eighty thousand of these bales are shipped each year to a Baltimore mill, where the tin is melted and made into window sash weights. Washington sells its trash tin for six dollars a ton. The annual return from this refuse rescued from ruin amounts to approximately 20,500 dollars.

BOTTLES of all shapes, sizes, and patterns are sorted from the trash by the hundred thousand and are sold to junk dealers who, in turn, return the glass containers to the beverage manufacturers and other establishments which use them. All the milk bottles are salvaged and returned to the central milk bottle exchange in the Capital City. The city of Washington sells its salvaged bottles for from 75 cents to four dollars and a half a gross. Broken glass, which is also reclaimed by the freight car load, brings six dollars a ton when eventually consigned to glass factories which use it as raw material in manufacturing glassware, window glass, containers, and like supplies.

One carload of paper, equivalent to 30 tons, is reclaimed daily from the refuse. The salvage value of this paper aggregates about eight dollars a ton. The paper is compacted into large bales weighing from 900 to 1200 pounds and is sold to paper mills throughout the United States. These mills soak and macerate the paper and reduce it to pulp. The final merchantable product, made from it is compressed cardboard. Washington gets 80,000 dollars for baled waste paper annually.

The rags are graded into ten different classes and are sold to junkmen, who finally deliver them at special contract prices to paper mills. The old sheets or window curtains which a Washington lady throws away this month, she may buy back in the form of fancy writing paper or wrapping paper several months later.

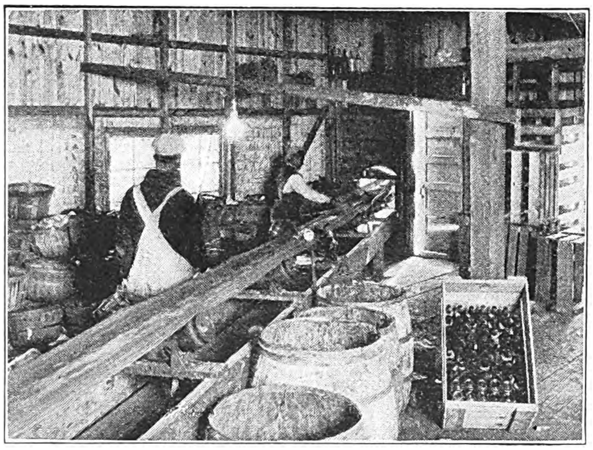
Mechanical appliances aid in the reclamation of the marketable materials from refuse. The trash is hauled by a large fleet of motor trucks and horse-drawn wagons from all parts of the District of Columbia to the trash plant. Each vehicle is equipped with a metal net like an old fashioned hay sling. This steel sieve is placed in the bed of each vehicle, with an extension reaching to the top of the load. When the truck arrives at the unloading platform, a steel cable operated by an electric motor links to the exposed end of the unloading net. In the twinkling of an eye, the load of trash is deposited on the platform.

Electric power operates also a paper plow to push the trash to an endless belt conveyor of steel. This corrugated belt is 300 feet long and three feet wide. It elevates the trash to the second floor of the salvage factory. Then it carries it, stream flow fashion, before 24 adept pickers and graders who sort the miscellany of rubbish as it flows methodically in front of them. Each picker is a specialist. One snatches bottles and tosses them into a special bin. Another picks rags. A third removes paper from the conveyor and throws it into gravity chutes which deliver it to the paper balers. Other workers handle tin cans, books, or magazines.

The trash which remains on the endless steel belt when it reaches the far terminal of its course is dumped on another conveyor which operates at right angles to the direction of the original belt of steel. Several pickers face this smaller conveyor and remove any saleable trash which by chance has escaped the first crew.

THIS conveyor dumps its remnant cargo into a mighty incinerator 12 by 50 by 75 feet in size. This refuse consists of soiled paper, wall paper, paint cans, wooden baskets, crates and bales, old parasols, worthless rags, and other debris. Four firemen operate the huge furnace which has a stack 65 feet high and 12 feet in diameter at the base. Smoke and fine ashes are the only residues of this incineration.

You can appreciate that the salvage is most painstaking when you learn that only two tons of trash are burned daily. Some 780 cubic yards of trash are delivered daily to the salvage station and all except this two tons are returned to the channels of commerce as merchantable articles. Here is a lesson in thrift and economical management which many other American cities might practice profitably. The majority of municipalities do not collect and destroy trash. They require individual home-owners to handle such activities. Washington, Baltimore, and Pittsburgh have blazed the trail and demonstrated not only that municipalities can perform such work, but that they can do it at a profit.



SORTING THE BOTTLES

Reclaimed bottles are carried on a rubber belt to a sorting room where they are graded and packed, ready for sale. They are used again as containers

The bottles at the Washington establishment are transported on an endless conveyor from the main building to the subsidiary glass salvage plant. As the flow of bottles passes the expert pickers, they remove the different sizes, shapes, and varieties. The bottles are then packed in crates and barrels and delivered to professional junk dealers.

THE broken glass is loaded directly into gondolas of 300 barrels capacity. The city trash plant furnishes irrefutable evidence of whether or not prohibition is enforced. Washington tosses almost as many spirituous liquor bottles into its ash cans as it did before the demise of John Barleycorn, according to trash plant records.

The best trash harvest of the year comes about Christmas time. The wrapping paper from countless Yuletide gifts is ultimately delivered to the reclamation establishment. This fresh, clean paper is simple to salvage and easy to sell. In Washington, the daily paper salvage increases to approximately 100 bales for several weeks after Santa Claus's annual visit. This is about double the ordinary paper recovery.

THE scent of romance and the spice of adventure find their devious ways even to such an extraordinary meeting place as the municipal refuse station. Newlyweds seeking lost rings come as a last resort to this rescue establishment. Senators' wives and congressmen's daughters who carelessly toss their jewelry bags into the discard drive in costly limousines to this fount of rejuvenation. One matron hurried there recently in search of her lost cat.

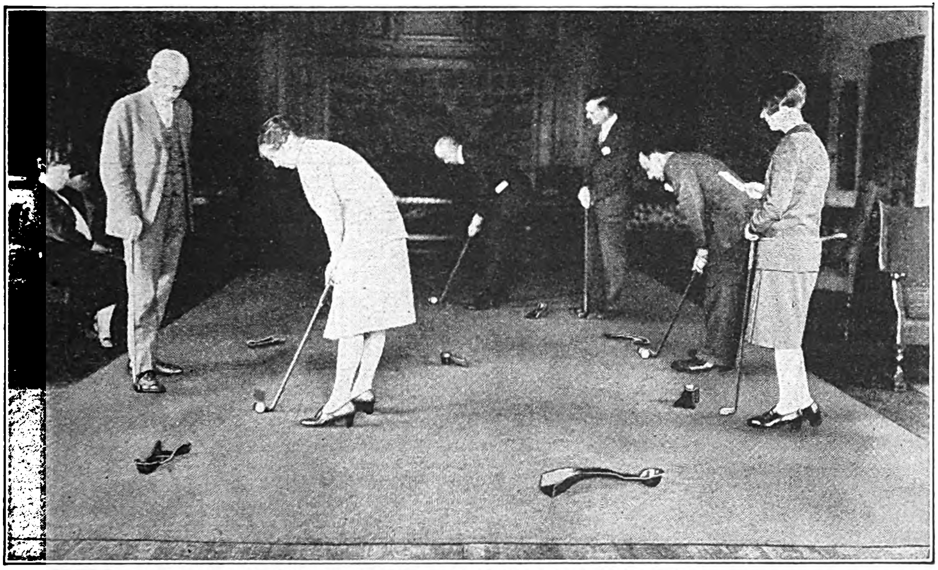
A prominent member of Washington society last winter rolled 25,000 dollars worth of diamonds in a chamois bag and carelessly left the bag on a table where her little son found it and carried it to the trash can. When the lady missed her costly gems, the police were called in, the house was searched and finally the lad confessed that he had played with the little bag of "pretties." An organized search was carried on at the trash plant for more than a week—but without success. The trouble is that the trash pickers learn of such losses too late. The trash is sorted and the residue destroyed as soon as delivered at the establishment. Usually the news of the loss of jewelry, money, and other valuables does not reach the refuse station until the rubbish which might have contained such precious articles has passed through the plant and is already consumed in the incinerator.

FUTURE SASH WEIGHTS

Millions of tin cans are collected and placed in a press where they are baled. These bundles are sold to a sash-weight manufacturer

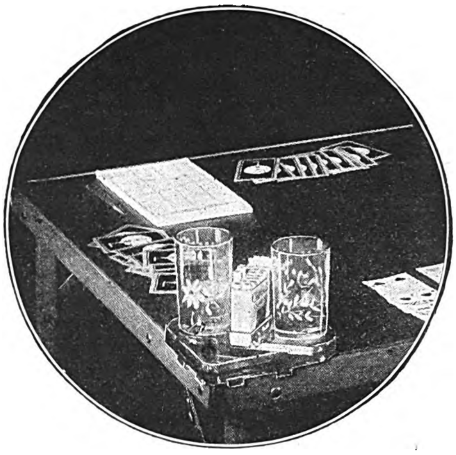
THE END

After passing before many trained sorters, the remaining junk is scrutinized again and then shot down to the huge incinerator



PORTABLE NINE HOLE GOLF COURSE

All one needs to convert a carpet or closely-cropped lawn into a "nine hole golf course" is a set of the runways and "holes" illustrated above. Each hole is different, and can be placed in any desired spot. As the game is played entirely with a putter, the ball is not lifted from the floor, and consequently it is safe to play the game indoors.—*Viophonic Corporation, 285 Madison Avenue, New York, N. Y.*



REFRESHMENT TRAY

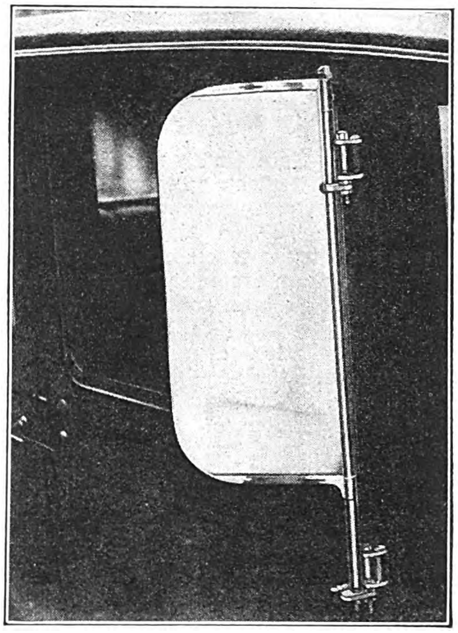
Easily washed glass trays now bid for a place on the card table. They are made in amber, green, or rose, and have places for two glasses, cigars or cigarettes, matches, and ashes.—*Louis Levein Sales Company, 24 West 23rd Street, New York, N. Y.*

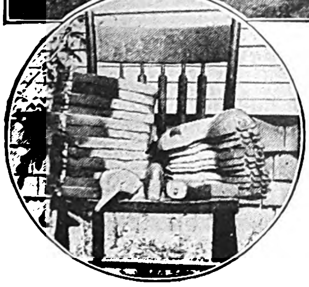
< DUCK HUNTER'S KNAPSACK

Designed primarily for duck hunters, this knapsack holds six boxes of shotgun shells in a separate compartment. The usual space is provided for food, clothing, utensils, and a thermos bottle. An overlapping top cover affords protection against weather, and leather shoulder straps with snaps add to its appeal to hunters.—*E. C. Montagne, 269 Pine Street, San Francisco, California*

CLOSED CAR WINGS >

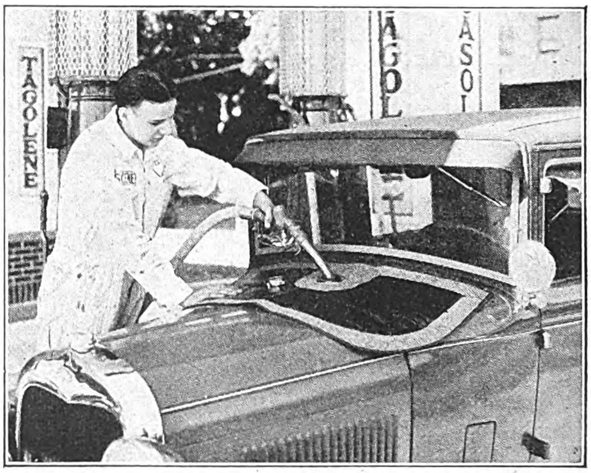
To overcome back drafts and make driving in a closed car more of a pleasure, wings have been provided that can be attached to the door hinges without marring the car. The wings turn with the door. They are intended to permit riding with windows open, to provide a maximum amount of fresh air without danger from drafts.—*Tonneau Shield Company, Inc., 518 57th St., New York*





IMPROVED DUCK DECOYS

These portable decoys can be assembled or taken apart quickly, and are said to be unusually lifelike on account of an improved flat bottom that enables them to "ride" the water like a live, wild duck. The bottom, body, and head are manufactured separately. The head can be adjusted easily.—*Ideal Decoy Manufacturing Company, Klamath Falls, Oregon*



COWL MAT PROTECTS FINISH

To protect the finish on cars having the gasoline tank located beneath the cowl, this rubber coated cloth mat has come into use at several service stations. The mat absorbs drippings and guards against scratches from the hose.—*Hinson Manufacturing Company, Waterloo, Iowa*

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

Extra Wheels on Buses for Greater Safety

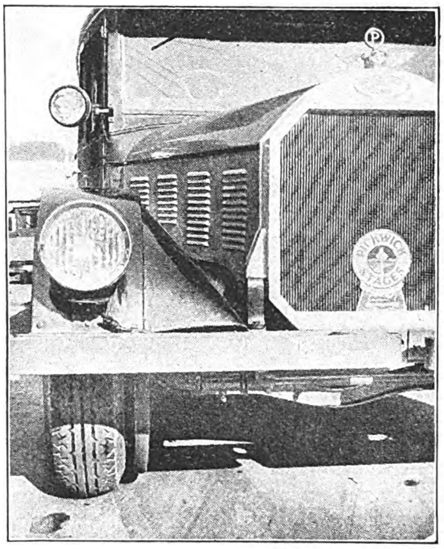
PASSENGERS in motorcoaches are often concerned with the question of what might happen should a tire go flat while the bus is traveling at a high rate of speed. It is a well known fact that under such conditions the driver may lose control and the vehicle crash into obstructions, resulting in injury or death to passengers.

A western stage system has adopted a special wheel which has an inner rim holding a solid rubber tire of a diameter slightly less than that of the pneumatic tire. If the service tire should go flat, the car will drop just enough for the solid tire to touch the road and will continue on this latter tire. Thus the driver retains control of his car and can drive slowly to the nearest service station, if necessary, for repairs. Besides the safety feature, the extra wheel has the added advantage of protecting the pneumatic tire from rim-cutting when deflated.

Two World's Largest Generators

THE Hell Gate Generating Station of the United Electric Light and Power Company, on completion of the installation of two 160,000 kilowatt (215,000 horsepower) turbo-generators, will become the largest steam generating station in the world, having a total generating capacity of 605,000 kilowatts (811,000 horsepower.)

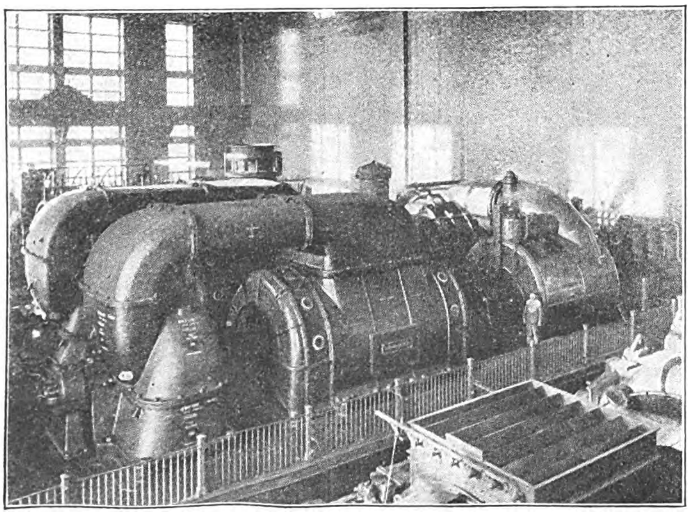
The installation of these two huge machines with their equipment of condensers, piping, cables, and switches, represents an investment of 6,000,000 dollars. One of these machines is now ready for commercial operation and the other will be ready in a few weeks. They give a striking illustration of the progress made in electrical engineering art. By increases made in the efficiency of the steam-producing and electrical parts of the machines, great increases in the total capacity have been made without corresponding increases in the bulk of machines. One of these 160,000 kilowatt machines, built by the American Brown Boveri Electric Corporation, will occupy a space in the station originally reserved, in 1921, for a machine of only 35,000 kilowatts and is being installed beside the second which is of Westinghouse Electric and Manufacturing Company construction. Each of these machines will be more than three times the capacity of any one of the largest machines now operating in the station. These other machines are two units of 50,000 kilowatts capacity, two of 40,000 kilowatts, and three of 35,000 kilowatts.



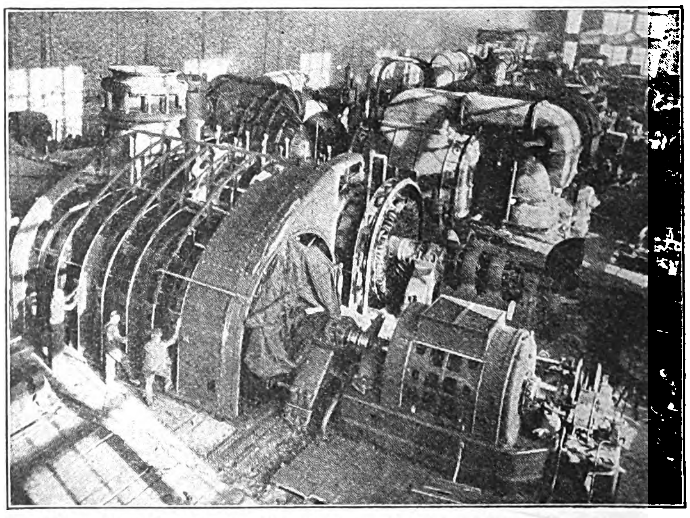
Bus wheel showing the extra solid tire wheel which comes into use if tire on the main wheel is punctured

One of these new machines operating continuously could have supplied all the power consumed in the entire country for lighting purposes in 1906. It can light 3,200,000 50-watt lamps. Each machine could lift the giant *Leviathan* steamship, of 59,000 tons displacement, into the air at the rate of one foot per second.

Both machines are designed to operate with steam at 265 pounds pressure at the turbine throttle, 725 degrees total temperature. The Westinghouse machine is somewhat lighter than that of the American Brown Boveri Company, the former weighing 673 tons as compared with 730 tons for the latter. The 160,000 kilowatt capacity of these machines is around 50 percent higher than that of the previous world's largest.



The American Brown Boveri 160,000 kilowatt generator which has just been installed in the Hell Gate Station in New York. It is in front of the second generator



The Westinghouse Electric and Manufacturing Company's generator, 160,000 kilowatts capacity but lighter than the one shown at left having the same capacity

Pitchforks Grow on Trees in China

EXPLORING in China in hopes of finding superior varieties of plants for introduction into the United States, a representative of the United States Department of Agriculture encountered a peculiar method of "growing agricultural implements." The explorer, P. H. Dorsett, observed, near a village about 50 miles southwest of Peking, long hedgerows of willows, but gave them no particular thought, as willows are grown commonly for hedges and for firewood.

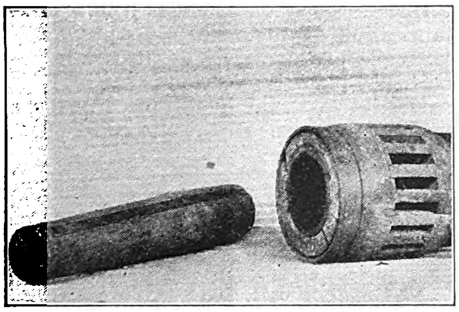
He learned, however, that these plants were selected for a special purpose. Grown as bushes, one or more shoots from each crown are allowed to grow 6 or 8 feet from the ground. These commonly produce branches at that height at points nearly opposite on the main shoot. The main shoot grows up in the center, making what is roughly a three-tined fork or trident. The lateral branches and the center shoot are finally cut back to within two or three feet of the point where the branches originate.

"The making of these branched sticks into harvest forks," says Mr. Dorsett, "is a more or less simple operation. The bark is stripped from the stem and branches. A dozen or more are placed at a time in an open-top brick-lined oven or kiln to be heated. The green wood, which is sprinkled with water from time to time, is soon steaming in the heat from the fire below. After the forks have been steamed in this way for an hour or two, the branches can be bent without danger of breaking. The forks are placed in a rough forming frame, and the branches are spaced to form the tines and give them the proper curve. The tines are held in place by pegs. They remain in the frame about six weeks, dry, and are stored. When they are wanted for the market, the tines are pointed and the handles smoothed for use. The finished article sells for about seven cents in American money."

Evolution of Logging Cart Bearings

EVERY so often an example of inorganic evolution appears that is interesting for the light it throws on the changing phases of human activities. This particular case has to do with the picturesque process of logging, and describes as well or better than any amount of words, the steady progress of the mechanization of lumbering processes.

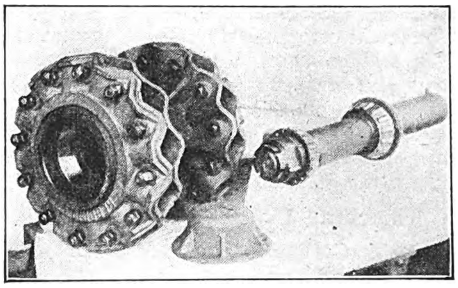
In the early days of lumbering, which are not so very long ago at that, horses did most of the heavy hauling, so speeds were low, and loads were light. For such conditions, a wooden hub and wooden stub axle on the log cart apparently gave perfect satisfaction. The bearing, if it could be called such, consisted of a rough cast-iron cylinder, slipped into the hub, which bore on two strips of one quarter by one half inch steel inlaid in the upper and lower surfaces of the wooden axle.



Old style wooden hub and wooden axle used years ago on logging carts

This cart served its purpose until the introduction of tractor logging. The increased power available made heavier loads on the carts possible, and increased the rate of speed. Thus it was necessary to strengthen the construction all around. The next step consisted of making the hubs of cast iron, with the bore machined. The axles were made of steel and machined to fit the hubs. Finally, the hubs entered the last stage of their evolution—the application of anti-friction bearings. The method of mounting the tapered roller bearings that were adopted in this particular case is fairly obvious from the illustration.

The previous type of hub had to be drenched in lubricant every so often if it was to keep operating properly. This meant not only that lubrication expense was high, but that a lot of it went for wastage. And, while the money spent for lubricating carts was a minor item in the general expense of operations, its reduction was desirable. Secondly, the plain bearing wore with use; swaying loads and rough ground shortened its life. Wheels became wobbly, and the cart had to be taken out for repairs before matters got to the point where some real damage might be done. With the present form of bearing mounting, these expense leaks are stopped. The cost of lubricant, and the frequency with which it must be applied are both reduced, and wastage is eliminated. Maintenance necessitated by bearing trouble has practically ceased to be a factor in operation. Briefly, the carts have been rendered more suitable for work under modern conditions.



Tapered roller bearings and steel hub of modern, swift, logging carts

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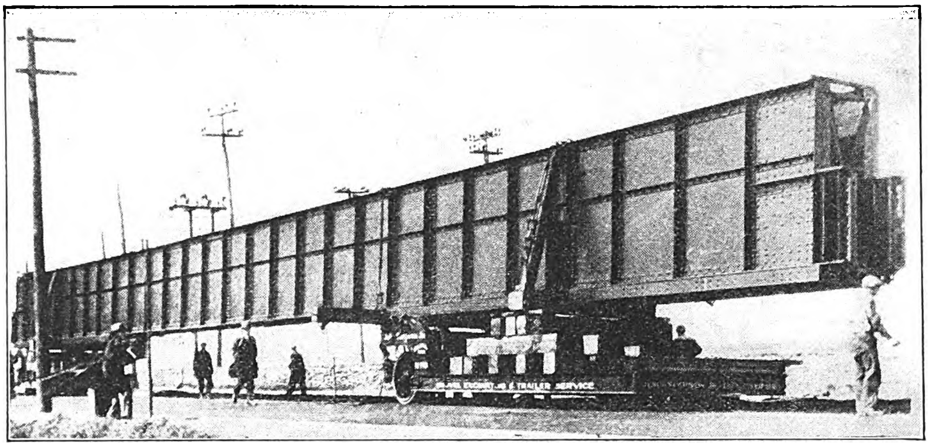


One of the massive girders that were moved from the freight yards to the point of erection on huge rubber-tired trailers, as described directly below

Trailers Carry Large Girders

SOME of the largest steel girders ever fabricated were recently moved on Rogers trailers at Bristol, Rhode Island, by the Callan Construction Company, who have a sub-contract on the Mount Hope bridge between Bristol and Portsmouth, R. I. The bridge when completed will be over a mile in length and one of the longest cable suspension bridges in the country.

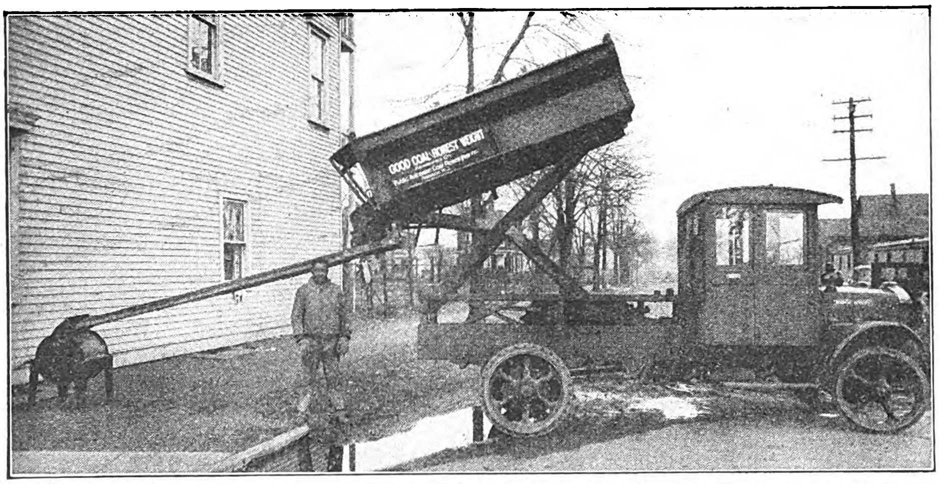
The girders came in pairs ranging from 140 feet to 150 feet in length and weighed 76 to 80 tons each. Four flat cars were required to transport each pair over a special route from the Bethlehem Steel Works to Bristol. Two 20-ton steam cranes with a crew of nearly 20 men unloaded and reloaded them onto the trailers on which it was necessary to build a supporting deck of 14 by 14 inch timbers, high enough and strong enough to support the weight and also allow the girders to pivot on corners. On top of this deck, crosswise of the trailer, was a balancing timber 20 by 20 inches by 15 feet long, and on each end was attached the lashing cable which passed up over the girder and was tightened with two-inch turn buckles. These were to prevent tipping and to act as stabilizers.

It was necessary to pull the trailers nearly a thousand feet and use 10,000 feet of three-inch plank to fill in between railroad rails to allow travel over rails in the freight yards before reaching the main highway. A five-ton Mack truck with platform body using two 14 by 14 inch timbers lashed lengthwise to the body with a 14 by 14 inch timber bolted crosswise of these two on the front of the truck served as a means of pushing the front trailer backwards and steering it, while two five-

Photographs courtesy Timken Roller Bearing Company

The creaking logging cart of yore. The bearings(?) on these were of wood; hence small loads were carried

Up-to-date transportation of logs from the forest to the lumber mill: cart with roller bearings, pulled by tractor



The way in which one man beat the cheaters. An invention for weighing coal as it is deposited in the cellar from a truck, to prevent short weight

ton Sterling trucks pulled from the front of the other trailer in getting onto the highway. The time in moving the first 1000 feet through the freight yards was about three hours, since telephone wires, trees, and curves required great care and patience, a false move meaning disaster. After reaching the main highway the Sterling trucks were placed ahead and the Mack used behind to help in steering and braking the load.

The total distance traveled was about two and one half miles and took between five and six hours. The trailers were the heavy duty, 28 ton, six-wheel, rubber-tired, gooseneck type with full fifth-wheel, spring-mounted front wheels. The four rear wheels are mounted on two pivoting axles with three-inch bridge at rear with Timken tapered bearings in all six wheels. The trailers showed no deflection under load and were not affected in any way. No tire trouble of any sort was experienced and the tires have been in constant use ever since.

Checking Up on the Coal Man

MAX GORDON, an insurance man, arrived home one evening and looked skeptical when Mrs. Gordon told him a ton of coal had been delivered at the house that afternoon. With a basket and a small scale he spent the evening reweighing that so-called ton and by bed-time he found it was 350 pounds short. The coal company would give him no satisfaction; neither would the city's department of weights and measures.

Every time thereafter that he bought coal he felt he was being swindled. His neighbors felt the same way about it, but none of them knew what to do about it. Gordon set out to solve the problem for all of them. He devised a sort of hopper through which the coal would pass in its course of being chuted from a coal truck to a cellar bin. Nothing like it had ever gone through the Patent Office and a patent was issued in short order.

The device is simplicity itself. A rotating drum is mounted on a support. In this drum are a number of partitions radiating out from the center shaft. The coal pours into one of the sections formed by the partitions until it fills up. When the section is full it becomes unbalanced and rolls over, spilling the coal out the other side and into the chute leading into the coal bin. As one section turns over to spill the coal into the cellar, another comes up into position to receive the coal coming from the truck. A predetermined number of sections full of coal make a ton.

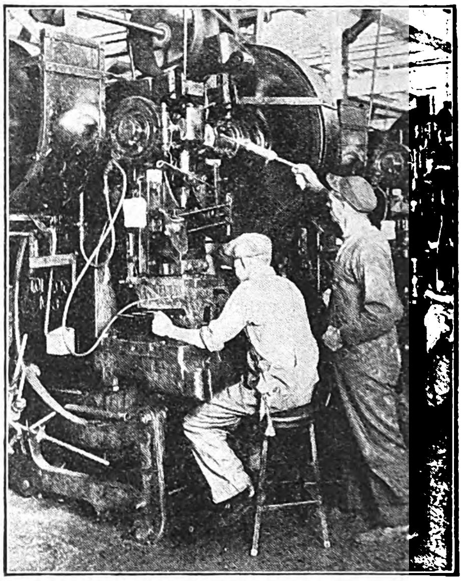
Gordon called the device an automatic coal reweigher and formed a corporation to direct its manufacture and sale. His neighbors hail it with delight, declaring that at last the day has arrived when they can be assured that they are getting their money's worth. To the inventor's surprise, however, the coal companies welcome the invention, declaring that now their customers can have no grounds for making ridiculous charges about being short-weighted.

Systematic Industrial Lubrication

ROMAN chariot wheels were drilled at the hub with an open hole for water or animal greases which were used as lubricants. Today this method of lubrication is still quite common in industrial plants; an inefficient open hole often serving as the only method of lubricating pulley bearings or shafting.

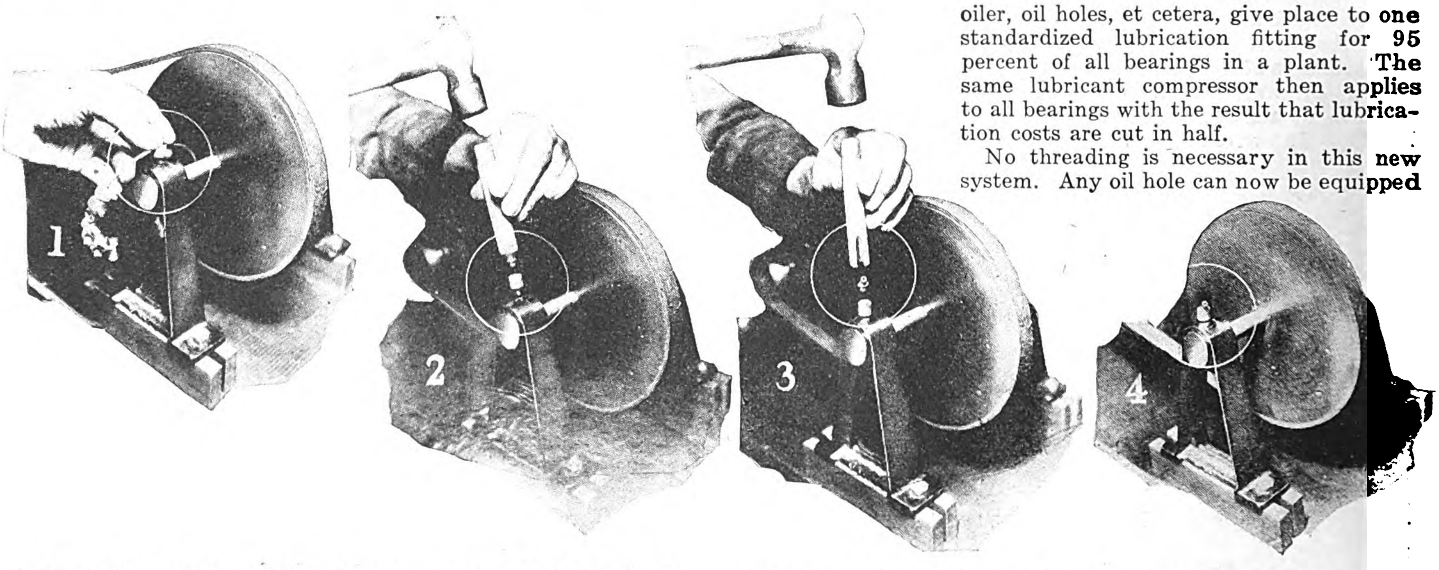
The announcing of drive fittings for all open oil holes by the Alemite Manufacturing Corporation promises a new era of lubrication in factories.

By placing high-pressure fittings in open oil holes, plant lubrication is standardized so that triple and quadruple lubrication including grease cups, oil cups, bottle oiler, oil holes, et cetera, give place to one standardized lubrication fitting for 95 percent of all bearings in a plant. The same lubricant compressor then applies to all bearings with the result that lubrication costs are cut in half.



Industrial lubrication by means of a "gun" like those used on cars

No threading is necessary in this new system. Any oil hole can now be equipped



Installing a drive fitting, for pressure lubrication, in the oil hole of a pulley bearing. In number 1, the operator is gaging the size of the present oil hole; in 2, he is driving a feather-edged bushing into the hole, no drilling or reaming of the hole being necessary; in 3, he is driving a ball valve into bushing; 4 shows completed installation with a high-pressure lubrication fitting, dirt-proof and permanently installed, in less than two minutes.

A reverse feather-edged bushing is driven into the open oil hole. These bushings are made in one sixty-fourth inch sizes from one eighth to onehalf inch. Special bushings are made for countersunk holes and for thin housings.

Into the top of the bushing a nipple with dirt-proof ball check valve is installed. An ordinary hammer and a set of three special drive tools form the complete equipment for installing this system in open oil holes.

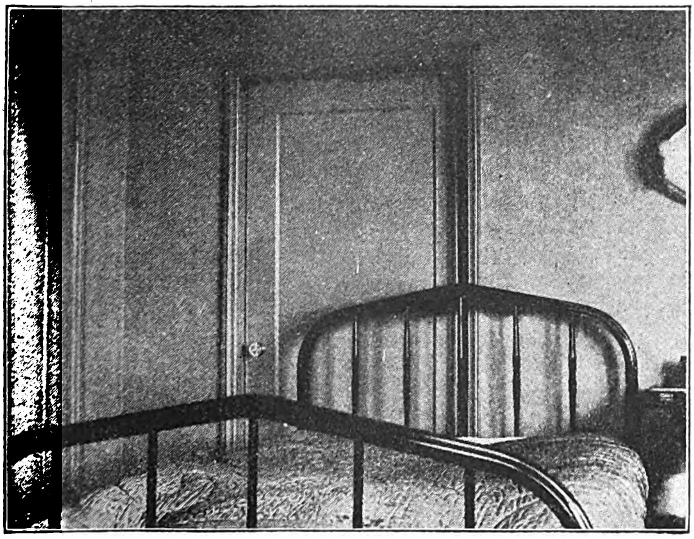
The Alemite plant lubrication system provides for handling the lubricant from its original barrel to the bearing without exposure even to daylight. This system precludes possibilities for waste, unnecessary labor, or failure of the lubricant to reach the desired spot between bearing surfaces.

Disappearing Closet-Bed

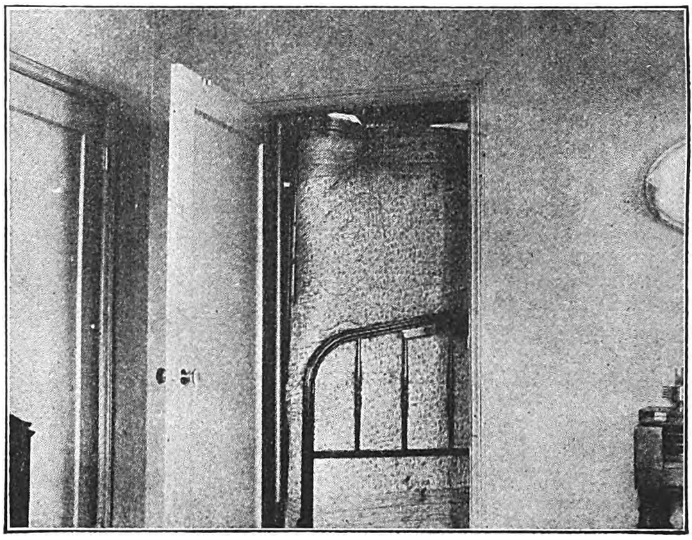
DWELLERS in apartment houses are familiar with beds that fold up and tuck away into closets. Whether or not they have used them, they have seen these beds and no doubt noted that when the bed is opened out and made ready for the night, the door to its closet cannot be closed.

The mechanism of a recently invented disappearing bed is so constructed as to allow the door to be closed at any time—that is, when the bed is in the closet or when it is down. The door is swung on a vertical rod as shown in one of the accompanying illustrations in such a manner that, although when the bed is ready for use it covers half the door space, the door itself easily slides shut.

The new invention is manufactured by Marshall Stearns Company, of San Francisco.



The new disappearing closet-bed. The door of the closet in which it disappears closes after bed is down

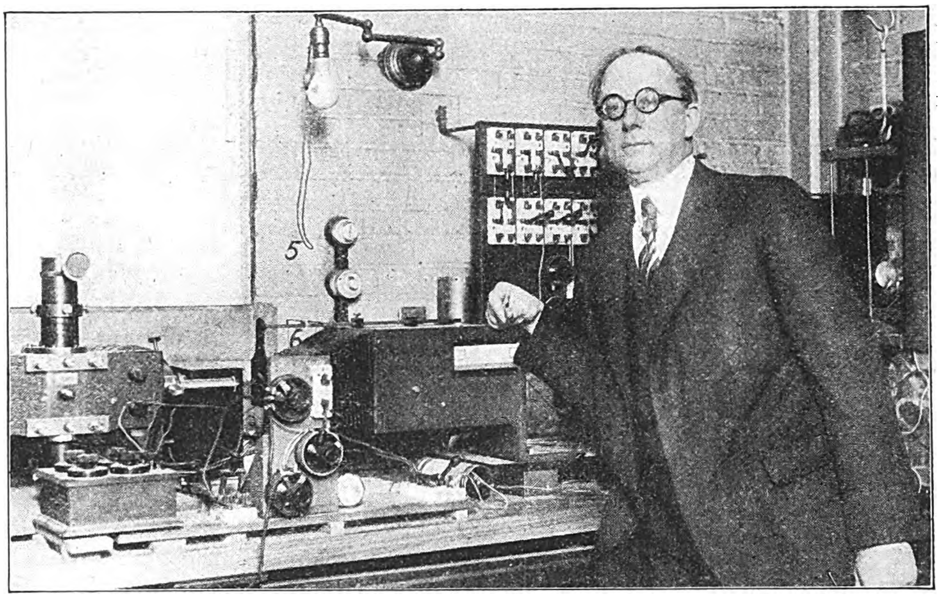


The disappearing bed folded away. In this photograph may be seen the vertical rod on which the door swings

Hearing the Eye See

PROFESSOR E. L. CHAFFEE, of Harvard University, has for some time been conducting experiments endeavoring to learn how the eye functions. Instead of attacking the problem psychologically as many have done, he has been following the methods of some early experimenters, namely Einthoven and Jolly, using a direct method of measuring the electrical changes produced in the eye when light shines on the retina. He has considerably improved and developed the methods used by these early experimenters and has been carrying on these experiments since about 1921.

The eye of the animal is taken out and cut in two, thereby exposing the sensitive retina surface. Electric terminals, consisting of fine threads, are connected to this retina and to a vacuum tube amplifier which, in turn, operates a sensitive galvanometer and recording apparatus. When light shines on the retina, the galvanometer moves in a rather complicated manner showing that the light falling upon the retina sets up a complicated effect in the retina and the connecting nerves. He has been studying these complicated electrical changes in an endeavor to unravel the intricacies of the processes of vision.



Professor E. L. Chaffee, who has been studying the eye, with the apparatus used in his experiments. With this apparatus he has heard the eye see

Although he and his associates have learned a great deal concerning the manner in which light sensations are transformed into nerve impulses and hence carried to the brain, their experiments have given so far very little aid to curing of troubles of the eye. One never knows the outcome of investigations of this sort and although it may be hoped that their results will be of benefit in diagnosing eye troubles, that is not the main purpose of the experiment.

The electrical changes produced in the eye consist in part of very rapid electrical vibrations and these vibrations, after passing through an additional amplifier, can be made to give out sound in a telephone. This leads to the interesting experiment of being able to hear the eye see. This experiment is perhaps more sensational than useful.

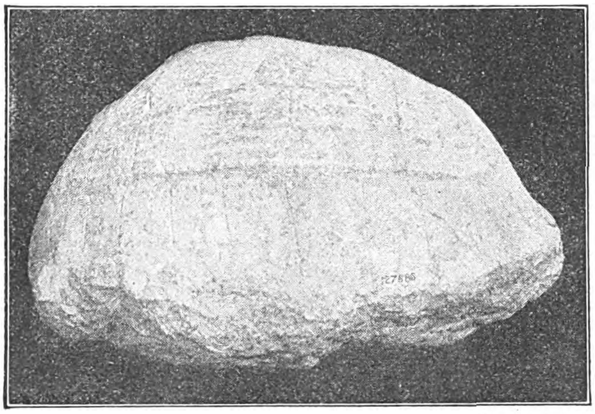
Professor Chaffee has been aided in this work first by Mrs. E. L. Chaffee and, during the last year and a half, by Miss Evelyn Sutcliffe.

Turtle Fossil Arouses Interest of Scientists

ONE fossil turtle, about a foot long, recently acquired by Field Museum of Natural History, has aroused intense interest on the part of distinguished scientists in three departments of that institution specializing in research along widely different branches of science, it was learned recently from Stephen C. Simms, director of the museum. The fossil turtle which is receiving so much attention is a gift to the museum from Mrs. Chauncey B. Borland, prominent Chicago society woman.

The department of anthropology is concerned because on the back of the turtle, which was found in China, are six mysterious ancient Chinese inscriptions believed to have been carved on the shell almost 4000 years ago. Dr. Berthold Laufer, curator of anthropology and noted Orientalist, is engaged in deciphering the archaic script. The turtle was regarded by the Chinese as a sacred animal with the magical power of accurately predicting the future, according to Dr. Laufer.

The department of zoology is deeply interested because study of the fossil indicates that it is an entirely unknown species of the genus Testudo. There are no zoological records in existence of any other turtle of its identical species, it was determined after an investigation by Karl P. Schmidt, assistant curator in charge of reptiles and amphibians. Mr. Schmidt made a thorough examination of the specimen before his recent departure as scientific leader of the Crane Pacific Expedition of Field Museum. Paleontologists in the department of geology are likewise interested because their study of the turtle indicates that it lived in the Miocene epoch some 19,000,000 years ago. Like the zoologists, paleontologists have no previous record of a fossil of a turtle of its species, according to Professor Elmer S. Riggs, associate curator of paleontology.



Looking like a simple piece of stone with a peculiarly marked, dome-shaped top, this large fossil turtle aroused the intense interest of three departments of a great museum. It is covered with Chinese inscriptions dating back, it is believed, 4000 years. Study of it indicates that it is of an entirely unknown species

Courtesy Field Museum of Natural History.

Apparently, millions of years after the turtle's death, its fossil turned up to attract the attention of some Chinese mystic, who carved the inscriptions on its back, says Dr. Laufer. The turtle was found in Shensi province, China, and was brought to this country by C. F. Yau. The inscriptions, delicately traced, are in the earliest stage of Chinese script, identical with that on the famous oracle bones of Ho-nan. At a very remote period the shell of a turtle was one of the chief elements in the art of divination in China, declares Dr. Laufer. For this purpose, shells were scorched over a fire, and the cracks occurring yielded a picture believed to foreshadow future events. The oldest examples of Chinese writing are preserved on tortoise shell fragments which contain questions addressed to soothsayers and the answers given by them, Dr. Laufer states.

"Divination was one of the dominating influences in ancient Chinese life," says Dr. Laufer. "The diviner was not a priest, but his position was comparable to that of a lawyer in our society. In the same way that the modern business man consults his lawyer on important questions, the Chinese did not make a step without asking the advice of a diviner. The oracles and sometimes the questions were carved on bones, turtle shells, and other such objects, many examples being extant."

The turtle will be placed on exhibition in the near future, after the inscriptions have been deciphered.

Aquatic Animal Remembers for Sixteen Generations

THAT "the elephant never forgets" is a favorite tradition of the circus lot and the zoo. But the big pachyderm's record has been badly scratched by a lowly animal that lives in the water, whose great-grandchildren of the 22nd generation remember a complex instinct possessed by their ancestor but which their more immediate forebears have never had an opportunity of exercising.

At the meeting of the American Society of Zoologists in New York recently Prof. W. A. Kepner presented the results of experiments which he and J. W. Nuttycombe, now of the University of Tennessee, performed on a tiny, almost microscopic, animal known as "microstomum." This creature is one of the many in the lower realm of nature that is armed with stinging cells in its body wall, partly for protection against its enemies and partly to assist in the capture of its prey. In the fierce economy of the lesser world of the waters, this animal feeds on a similar but smaller form, the hydra, which is also armed with stinging cells. It apparently does not like the hydra very much, for it will not eat it except when its supply of stinging-cells is low. Then it swallows hydra readily enough, and appropriates the ready-made cells.

The two experimenters grew a strain of microstomum for 22 generations, without ever giving them an opportunity to meet and feed on hydras. Yet at the end of that time the animals went through the same performance their ancestors had been used to: swallowed the hydra, turned over the stinging cells to certain wandering cells of their own bodies, and eventually set them in order among their own stinging cells. In another case, a 16th generation microstomum had its upper and lower ends cut off. The middle third of the body regenerated new ends, and the "revised" animal went through the long-disused performance as though it had been used to it all its life.—*Science Service.*

Royal Photographic Society's Annual Exhibit

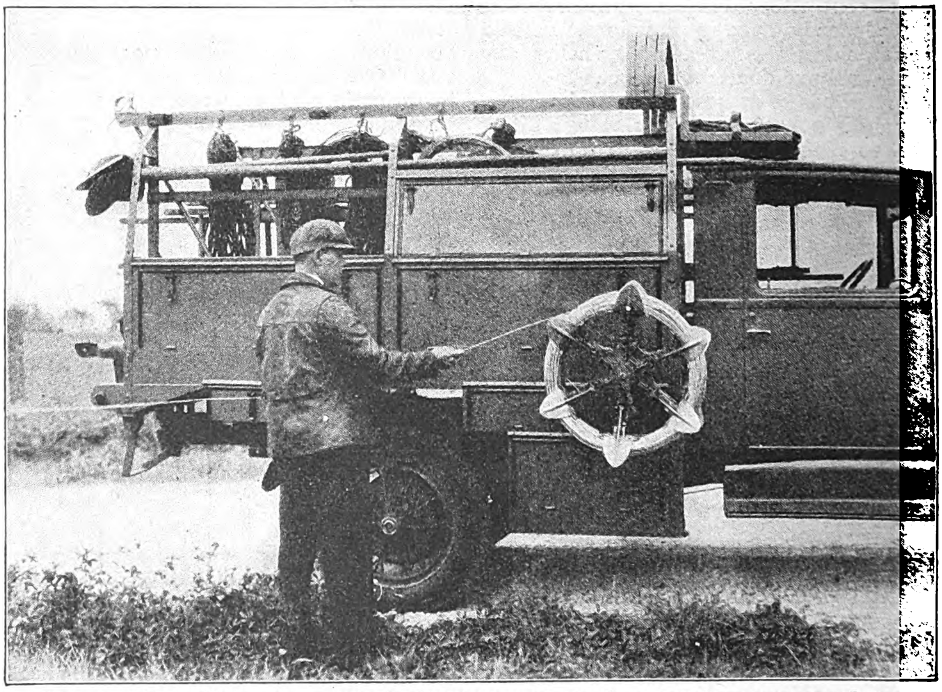
THE 74th annual exhibition of the Royal Photographic Society of Great Britain will be held this year from September 14 to October 14.

The secretary wishes a strong American respresentation, since active support from representative scientific workers in this country contributes largely to the success of the exhibition.

Exhibits intended for the scientific section may be sent to the Eastman Kodak Company, Rochester, New York, in care of Mr. Alexander Murray, and should reach him not later than July 15.

Eighty-four Elements in Single Collection

SHORTLY after publication of an article in our February issue entitled "Best Collection of Rare Gases," Mr. Edward S. Candidus of the Brooklyn Edison Company, Inc., wrote us relative to a collection of chemical elements he has made. His comments are so interesting that we quote below a part of his letter:



A new collapsible power reel of aluminum or steel, recently announced by the Highway Trailer Company, Edgerton, Wisconsin. It collapses to permit placing or removing a coil of wire or rope. The winch takes power from the motor of the truck. It is used for pulling in aerial or underground cables

"Two years ago I started collecting for educational purposes the known chemical elements. To date I have succeeded in procuring specimens of 84 of the 90 known elements. Included among the 84 are specimens of pure krypton and xenon sealed in special tubes. These tubes were made up and given to me, along with tubes containing nitrogen, oxygen, argon, hydrogen, neon, and helium, by the Air Reduction Sales Company.

"You will gather from the enclosed copy of their letter to me and the accompanying instruction sheet [*Not reproduced—Editor.*] that krypton and xenon are now available from the atmosphere on a commercial scale in the United States.

"Spectral tubes containing krypton and xenon may also be seen on display at the American Museum of Natural History in New York City.

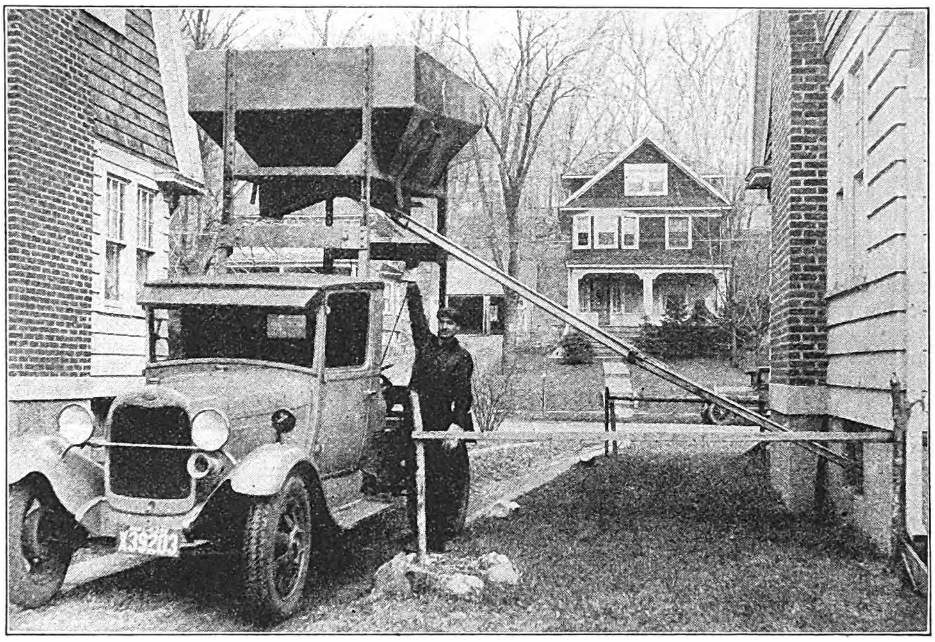
"However, this should not detract from the glory of research workers out west because it was necessary for me to go all the way to one of our great mid-western universities for pure specimens of metallic praseodymium, neodymium, yttrium and lanthanum, and salts of thulium, terbium, dysprosium, holmium, hafnium, samarium, gadolinium and ytterbium."

It is doubtful if there exists in this country and perhaps in the world, a collection equally as complete as this one.

An Elevating Coal Delivery Truck Body

COAL dealers, especially in small or suburban towns, are often faced with the problem of delivering coal from a narrow driveway into the cellar window of a home. Usually it is practically impossible to back up a rear-delivery truck so that the coal may be delivered through a chute, thus necessitating delivery by means of a shovel or in baskets.

A new delivery body for Fords, Chevrolets, or other light duty one-ton to two-ton trucks, announced by the Thomas Wright Company, of Jersey City, New Jersey, elevates vertically and delivers from the side. With this body it is simple enough for the coal truck to drive into any narrow driveway, install a chute to the cellar window and elevate the body to the necessary height. The body is hoisted either by hand or by a power hoist or by both. If raised by hand, one man can perform the operation in a minute and a half. The body is made of a special rust-resisting steel. Each body is equipped with one dividing board for two single tons, one two-section galvanized chute, and a basket board. The hoist frame is made of heavy angle iron.


Elevating delivery body which was especially designed for coal trucks. The body is staunchly built and may be used on the chassis of a small truck

Scientist Squeezes Gas Out of Iron and Steel

PEOPLE who live in wooden houses can always chop down a door or a partition to keep warm, but until now, ham and eggs could never be cooked with a leg of the kitchen range, nor was it possible for marooned motorists to run the "gasoline wagon" with a spare wheel or a set of fenders stripped from the car as fuel.

But now, when the fuel tank goes empty on the road, just remember there is enough gas soaked away in the car's iron and steel to run it for miles. A few old stove lids or grate shakers contain enough fuel to boil the morning coffee or fry the ham and eggs. *The trick is to get it out.*

N. A. Ziegler, scientist in the Westinghouse Research Laboratories, can do it. He squeezes fuel gas out of iron and steel like water from a sponge.

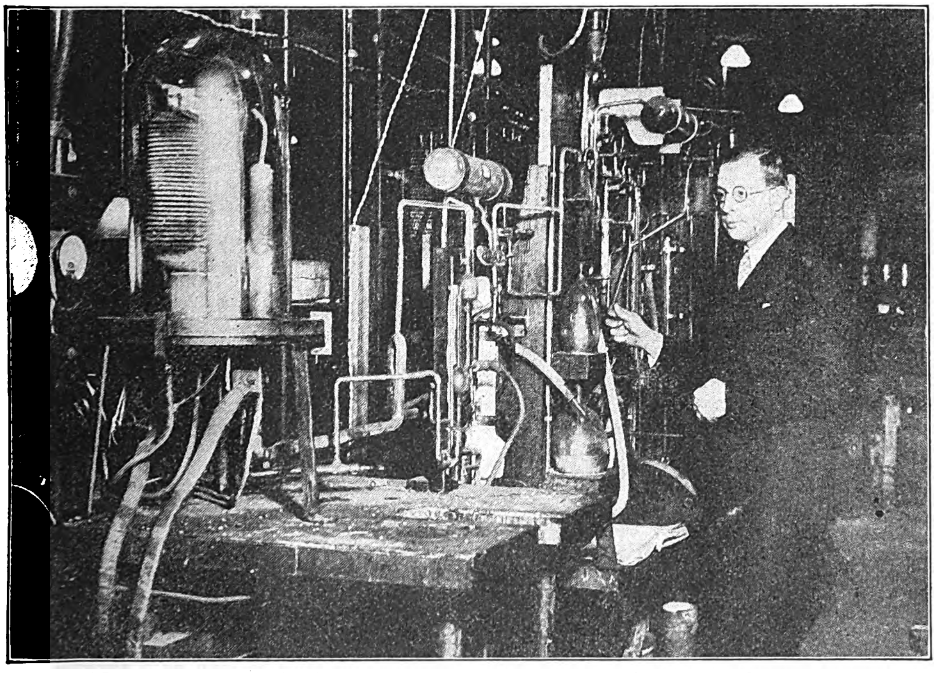
An old automobile piston, for example, gives up 33 times its own volume of fuel gas; wrought iron and steel give up gas in less amounts. This gas, which burns with a pale blue flame, can be used to operate a gas stove and, with proper carburetor adjustments, an automobile. A couple of cubic feet of cast iron gives enough gas to furnish about ten horsepower for twelve minutes.

While automobiles have usually been operated from liquid fuels, it will be remembered that during the war, motor cars in England and France were operated from gas in bags. Even now there are trucks running in Europe and South Africa, operating from a similar fuel gas made from coal in a little producer on the truck.

The iron from which gas has been squeezed has a brilliant, lasting sheen, instead of the dull rusty surface common to cast iron. It is better for making magnets than ordinary iron. This is the principal value of the process, the inventor thinks, since, at present, the cost of getting the gas is far greater than its value as a fuel. Better iron for electrical machinery, however, is very important, since millions of pounds are used annually and cheaper and better electrical machinery affects the public generally.

Mr. Ziegler uses a big high-frequency induction vacuum furnace for extracting gas from cast iron. A powerful vacuum draws off the gases that boil out. The furnace quickly melts the hardest steel, but will not burn the hand nor scorch a cigaret paper.

The furnace is built of glass and, as the gases are drawn off, glows with a brilliant, soft blue light, believed to be the same in character as the Aurora Borealis, or Northern Lights.


Mr. N. A. Zeigler with the apparatus which he has developed for extracting gas from ferrous metals. By his process he obtains pure iron and steel

Learning to Use Our Wings

Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

An Interesting Light Plane

DESIGNING an airplane is not entirely a matter of consulting one's inner consciousness and evolving a perfect design therefrom. It is advisable to study magazines of all types to see what other people are doing, to visit flying fields and air shows, to fly with an eye to useful observation, to talk with pilots, to talk with passengers and laymen who are users of planes, et cetera. For example, we will study the specifications and photographs of an interesting light plane, the *Starwing*, built by the American Aircraft Corporation. This is a low wing two-seater, equipped with the Le Blond 60 horsepower, five-cylinder, air-cooled engine. Every line of the description can be studied usefully.

Being light in weight, one man can easily handle it around the hangar, but still it is large enough and heavy enough for perfect riding comfort. Its total wing span of 29 feet permits housing in a small inexpensive hangar.

These are good points. If private planes are to become popular, they must indeed be easily handled and housed.

Tandem seating arrangement is used, since this gives more room for the pilot and passenger, lessens the chance of interference with the pilot's operations and makes long trips more comfortable. The cockpits of the *Starwing* are only six inches narrower than the latest type side-by-side seating arrangements of other types of airplanes.

We are not so sure that for sport planes the tandem arrangement is the best. Surely for companionship and perhaps also for ease of instruction, side-by-side seating has some advantages. But we do like the comfortable width of the cockpit, if this can be attained without undue sacrifice in weight and aerodynamic resistance.

All cowling is removable, exposing the entire motor, gasoline tank, and all necessary connections.

Any one who has worked around a car or an airplane will appreciate this. It is hard enough to get things right when they are entirely visible. It is far harder to work by feel alone.

The wings are attached to the lower edge of the fuselage, independent of each other, and externally braced with sturdy V-type compression struts, located in positions that eliminate climbing over them when entering the cockpits. Each wing being an independent unit, replacement costs are greatly reduced.

To this a number of criticisms can be made. A wing continuous under the fuselage is somewhat cheaper to build, in the first place, and is also somewhat stronger for the same weight. Still, there is a good deal to be said for the independent unit idea. The side view illustrates clearly how easy it is to enter the cockpit, and this will appeal to any one except the youngest and most agile air traveler.

The landing gear of the *Starwing* has a nine-foot tread and is placed directly under the external wing bracing. It has been proved that this type of gear enables the ship to be easily handled on the ground, and controlled in cross-wind landings, having no tendency to ground loop. By placing the wheels exceptionally far ahead of the center of gravity, the danger of nosing over is practically eliminated. The position of the gear makes a tail-high landing practically impossible, since the tail is forced down as soon as the wheels touch the ground.

It is indeed one of the advantages of the low-wing monoplane that it is possible to use a very wide tread landing gear, without any clumsiness in the design. A high-wing monoplane has its width of tread limited by the fact that the landing gear struts must go to the fuselage, and if the wheel tread is very large, either the struts must go to the upper wing and become unduly long and heavy, or else the strength of the landing gear is seriously impaired. Of course the high-wing monoplane is likely to be a little more stable than a low-wing job. If a low-wing job turns over on its back in a rough landing the occupants may be seriously injured, whereas with a high wing, they are protected by the wing itself.

The reader will see from these facts that no one type can be made to combine all the possible advantages. It is very desirable to put the landing-gear wheels far ahead of the center of gravity, from the point of view of safety. But when the wheels are far ahead of the center of gravity, it is difficult to lift the tail off the ground on making a get-away. It is advisable in such cases to have very powerful elevators, and even then, the get-away is apt to be a trifle slower than when the wheels are at a more reasonable distance ahead of the center of gravity.

The photograph of the front of the airplane shows the excellent way in which the landing gear structure and the wing bracing work together.

In the side view we note the neatness of the nose and cowling, and the excellent all-around vision of the man in the front seat.

Another point that the description of the *Starwing* stresses is that the fuel feed is entirely by gravity. Unfortunately, this means that the tank is placed just behind the fire wall, and immediately ahead of the front occupant. This is not, perhaps, the best disposition from the point of view of fire hazard. In a high-wing job, the fuel can be placed in the wing away from the cockpit, and not in line with the engine, so that fire hazard is probably lessened. A better arrangement, from the fire hazard point of view, would be to place the fuel in the wing of the low wing job, but this means the introduction of a fuel pump, and a little complication.

What makes plane design so interesting, and at the same time so irritating, is this necessity for compromise and the apparent impossibility of getting every point just right.

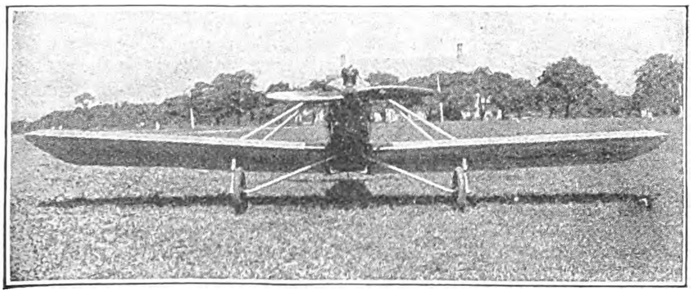
Practical Flying

MAJOR BYRON Q. JONES of the Army Air Corps is one of the first pilots the army ever trained, and he has viewed aviation from many angles, including instruction, personnel, engineering, and tactics. His book "Practical Flying" (published by the Roland Press) is an authoritative and attractive treatise on this subject, which will be invaluable to all students and prospective private owners.

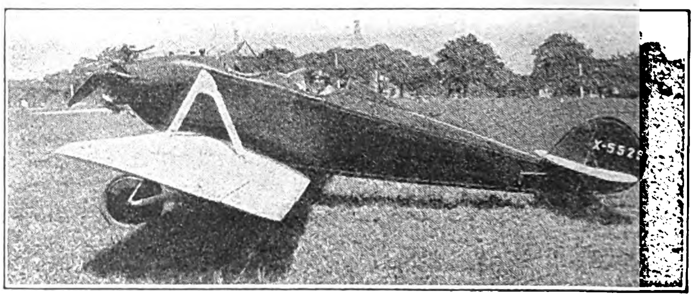
A man can learn to solo in a few hours, at a cost of between two hundred and four hundred dollars, but Major Jones considers this to be only an elemental course. "A student just completing his elemental course is about as qualified to start off on his own, as is a country beginner in auto driving to undertake fast driving in congested city traffic." This is a timely warning.

Flying instruction should be of short duration. Thirty minutes at a time is recommended. Lengthy instruction periods fatigue the student and make him careless. The average man is advised to take only two hours instruction per week.

We have become accustomed to dual instruction, in which a pilot in the front cockpit signals to the student in the rear cock-



The "Starwing" is a light, two seater airplane which can be easily handled around the hangar by one man



This side view of the "Starwing" shows its clean lines, and the low-wing monoplane features described above pit. This is the original Wright system. It is a curious reminiscence of old times to read of the Curtiss system, now long abandoned, in which the student was put into a single seater with only power enough initially to taxi along the ground. "When the student had become proficient in handling the plane on the ground he was given just enough power to get off the ground for a short hop." And so with gradual increase of power he would go through the entire course. Major Jones thinks quite correctly that a reversion to this early system would be costly, dangerous, and purposeless. Still it is curious to think how many excellent pilots were produced by this "self-help" method.

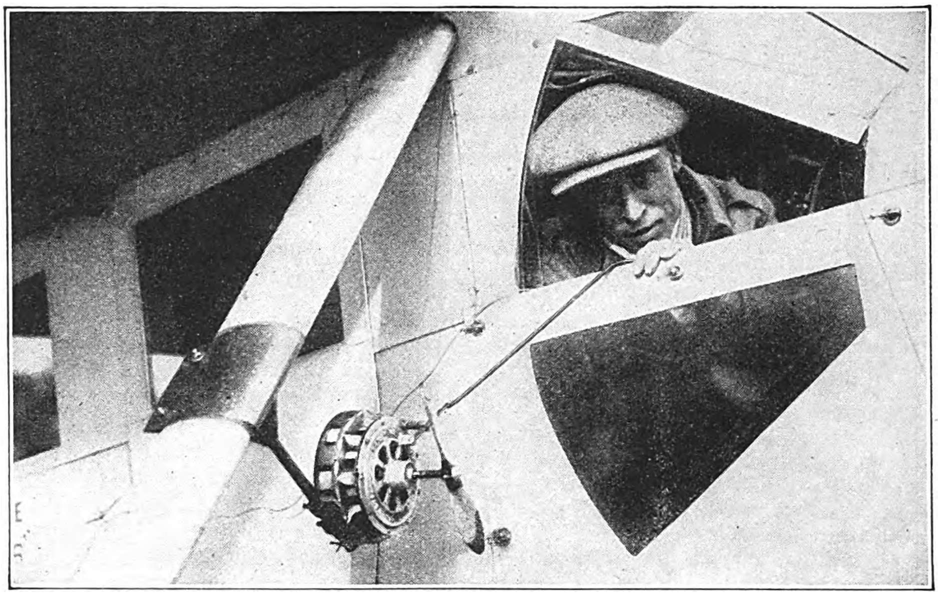
The book teems with real practical tips. The orthodox, open-cockpit plane will soon soil a man's clothes. Mechanics climb in and out of the cockpits with dirty shoes and greasy clothes, soiling the cockpit. The exhaust and oil thrown by the engine may help in the dirtying process. The beginner must be prepared to ruin a suit of clothes or to wear overalls. Gloves are not necessary in summer. Warm, fingerless gauntlet gloves are best for winter. A good fitting helmet is necessary and should be provided with large "powder-puff" ear muffiers sewed on the inside.

The answer to the question "Can anyone learn to fly?" is that the average normal person who *wants* to fly can learn to fly. But there must be a real sub-conscious desire to fly.

Too much concentration is harmful. In the old bicycle riding days it was a common experience that if a beginner fixed his mind upon an obstacle he was afraid of running into, it was almost a certainty that he would do just that. Erroneous concentration, in Major Jones' opinion, is responsible for 90 percent of our flying accidents. The pilot must be on the alert but should not concentrate on the possibility of trouble.

Do you ride a horse mechanically or do you adapt yourself to its natural rhythm? In driving a strange car do you force it, or learn to adapt yourself to its peculiarities? These questions settle your adaptability and hence suitability as a pilot.

If we quoted all the interesting and valuable information conveyed by Major Jones we should have no space for anything else in our columns.



Showing the location on the side of the fuselage of a wind-driven siren which sends out a note which operates apparatus to light the airport automatically

Lighting a Field Automatically

THE Westinghouse Electric and Manufacturing Company has developed a "robot" which is likely to be of real service in keeping down the operating expenses of airports, because it will turn on the lighting system of an airport only when needed—when a pilot is about to make a landing at night.

At the side of the plane there is mounted a siren operated by a wind-driven propeller. When the pilot releases the brake of the siren, its piercing scream acts on a sensitive pick-up on the ground which, in turn, puts into action the electric lighting system. The siren can be set on a note of any given frequency so that other noises are not likely to set the apparatus into action. The sound-sensitive apparatus is also a part of Televox, the "mechanical man" invented by Roy J. Wensley. Recent tests made at the Newark airport have been successful.

"Airmen or Noahs"

A RECENT English book, by "Neon," entitled, "The Great Delusion," attacked all flying in a spirited and literary fashion, but it was marred by mis-statements and exaggerations. We were glad to read an effective rejoinder in "Airmen or Noahs" by Rear-Admiral Murray F. Sueter (published by Isaac Pitman and Sons, New York).

Apart from its controversial value, "Airman or Noahs" gives a vivid and interesting survey of all flying matters, and will appeal to almost every layman and to many technicians. We particularly like the treatment of naval aviation, and the discussion of its utility as a means of attack. The conclusions of this careful and erudite author are particularly striking.

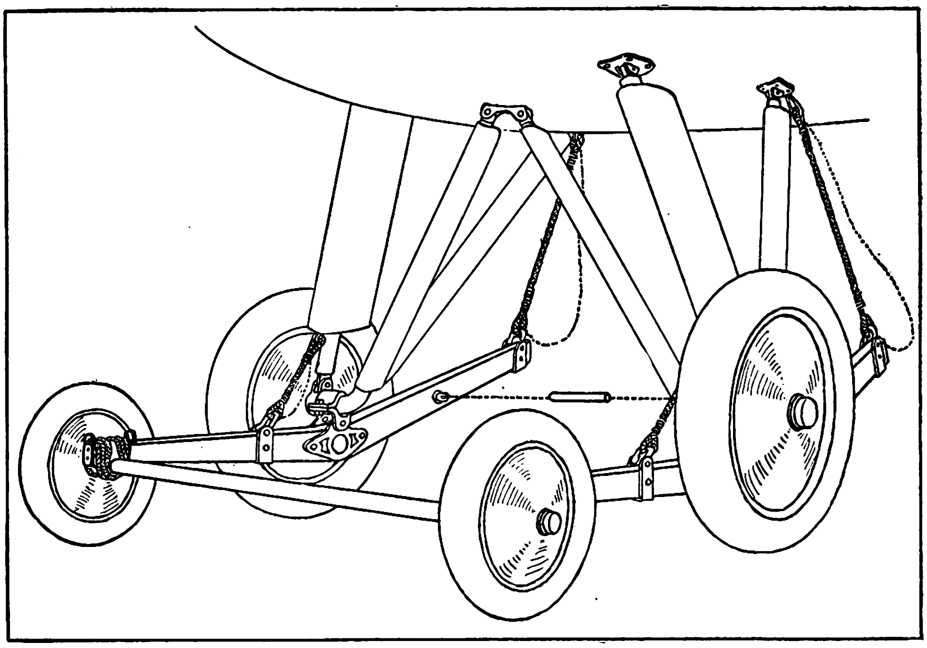
"The truth of the whole matter is that we must educate the youth of this country (England) in the advantages to be gained by this nation in air development, particularly in regard to communication and air travel. . . . At present there are no exact flying statistics available. But what there are, show that in the last two years air travel has been much safer than generally realized. This safety is year by year increasing, whereas that of road travel, due to the very large number of motor-bicycles, motor-cars, lorries, et cetera, on the road, would appear to be decreasing."

How well these remarks apply to the United States!

The Ideal Sport Plane

THE announcement of the Light Plane Prize of the SCIENTIFIC AMERICAN was naturally in the form of an official statement, and the committee could not voice its sentiments as to the exact character of an ideal plane. It was far better to state that a design for an ideal light plane was desired, and let it go at that. But it may be of interest to possible entrants to quote from an editorial in *Aviation*, whose staff

Quite a number of accidents have occurred at airports, in which passengers or visitors have walked into rapidly whirling, and therefore invisible, propellers, with disastrous results. This photograph shows an idea which may prove to be a useful safeguard against this danger. The end of the propeller is painted with colored stripes which attract the eye when whirling



Drawing shows the component parts of the Fritsch landing gear described below

has been giving serious consideration to the requirements of the light sport plane. As a result of their study, they make the following recommendations.

The light plane should have the high speed of a Lockheed *Vega* (somewhere around 140 miles per hour), the slow landing speed of an *Avro* (say 35 miles per hour), and the quick take-off of a *Waco 9*, powered with a Whirlwind engine. It should have the maneuverability of a Curtiss pursuit, the inherent stability of an *Arrow Sport*, and the long life of a "Jenny" (that is to say, the well known Curtiss *JN-4*).

It should be an amphibian, and although normally seating two people, it should have an extension feature which would give it the carrying capacity of a Ford transport. The forward and down vision should be similar to that of the early pusher types, and the vision to the rear should be unobstructed. The engine should be of low power, preferably with four cylinders, and preferably it should be of the Diesel type.

It is a little too much to ask that this will be realized in the near future, particularly if the price of the plane is to be limited to two thousand dollars. Still there is nothing like visualizing the ideal, and then trying to live up to it.

The Fritsch Landing Gear

AT the recent New York Air Show, a model of the Fritsch landing gear was exhibited. It is a novel arrangement which has some possibility of increasing the safety of a training plane. The design is shown diagrammatically in one of our sketches. The apparatus consists of two auxiliary wheels, mounted at the forward end of two horizontal arms or levers, which are pivoted at their centers to the landing gear. The rear ends of these arms are jointed to the fuselage by rubber shock absorbing connections, and function only when the landing angle is abnormally steep. In such cases the auxiliary wheels come into contact with the ground first, so that there is a downward pull on the fuselage in the rear of the center of gravity. This helps to restore the plane to the proper landing attitude. When this angle is reached, the pressure on the auxiliary wheels is released and the regular landing gear comes into use in the normal way. The purpose of the auxiliary landing gear, of course, is to decrease the dangers due to bad landings or uneven ground.

The action of this landing gear is further illustrated by three diagrams. In the first diagram, the airplane is shown landing at an extreme angle. There is, of course, danger of the plane nosing over. The second diagram shows how the pressure of the ground acting on the front wheels is transmitted as a pull to the rear shock absorber, and thus tends to pull down the rear of the fuselage. In the third diagram the plane is shown restored to its normal position.

The Fritsch landing gear is said to have been used successfully on a number of French training planes. Nevertheless, it remains to be seen whether designers will accept the device which adds to the expense, weight, and aerodynamic resistance of the airplane chassis.

Practical Training in Aviation

ADVANCED instruction in aeronautical engineering now has been placed on a very sound footing, thanks largely to the Daniel Guggenheim Fund for the Promotion of Aeronautics. Also, this type of instruction is more thoroughly understood. The student must have a solid foundation of mathematics, mechanics, and general engineering on which to base his specialized work in aerodynamics, design, stability, engines, et cetera.

Training for activities in aviation other than those of the technical engineer is in a much more uncertain condition. There are now many openings in the aviation industry for men, but they must be well trained. It is difficult for a man to break into aviation just because it has a romantic appeal for him, if he has no specialized knowledge.

The Department of Commerce analyzes the positions which may be obtained after proper training and experience as follows: (1) Pilot. (2) Mechanic. (3) Aeronautical engineer. (4) Factory man. (5) Airport designer and constructor. (6) Airport ground man. (7) Radio operator. (8) Traffic agent. (9) Advertising and publicity man. (10) Airplane salesman.

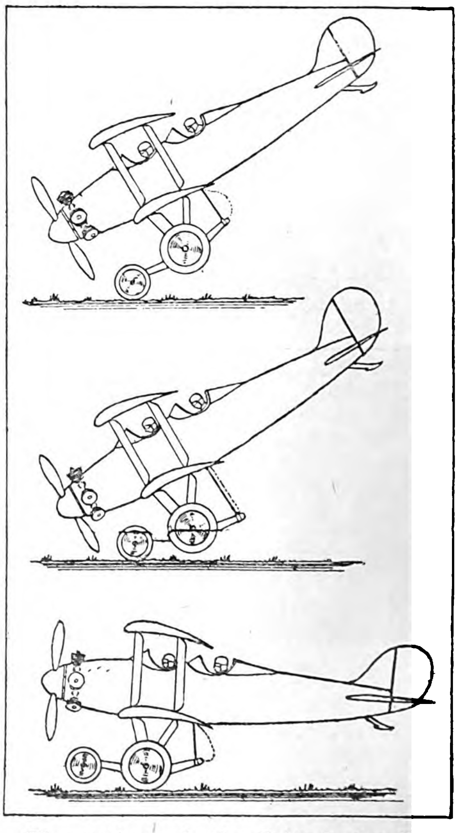
A pilot with several hundred hours of experience in all kinds of flying, including cross-country work, has plenty of openings at this time. There are fewer, but still there are some, openings for men who have had 50 hours solo flying. However their activities are restricted by the Department of Commerce. A man with a 50-hour license can carry passengers for hire only within a restricted area around an airport. Or he may engage in such flying operations as cotton dusting, aerial photography, et cetera. But he may not carry passengers or property for hire between states.

Pay for pilots varies. On most contract mail routes, pilots receive a base pay, with a percentage for miles flown with mail. Total earnings may run to 5000 dollars a year or more. Pilots operating at airports and carrying passengers up for short hops receive from two dollars to five dollars for each passenger.

Before enrolling in a training school, the student should take the Department of Commerce physical examination, so that he may receive a student permit.

Great care should be exercised in selecting a training school. Opinions should be secured from past or present students of the school. There is one criterion of a general character by which schools can be judged, and that is whether they conform to the air commerce regulations. Also, the best schools give as much care to ground training as to flight training.

The average training school gives 10 hours of dual instruction, and one or two solo flights. But the man who expects a job after such short work will be sadly disappointed. He has only begun. He should put in 50 hours more before even attempting to carry passengers near an



The action of the Fritsch landing gear when a plane so equipped lands at an extreme angle to the ground

(*Please turn to page* 470)

Industries From Atoms

Advance Made in Industrial and Experimental Chemistry

Chemical Effects of a Meat Diet

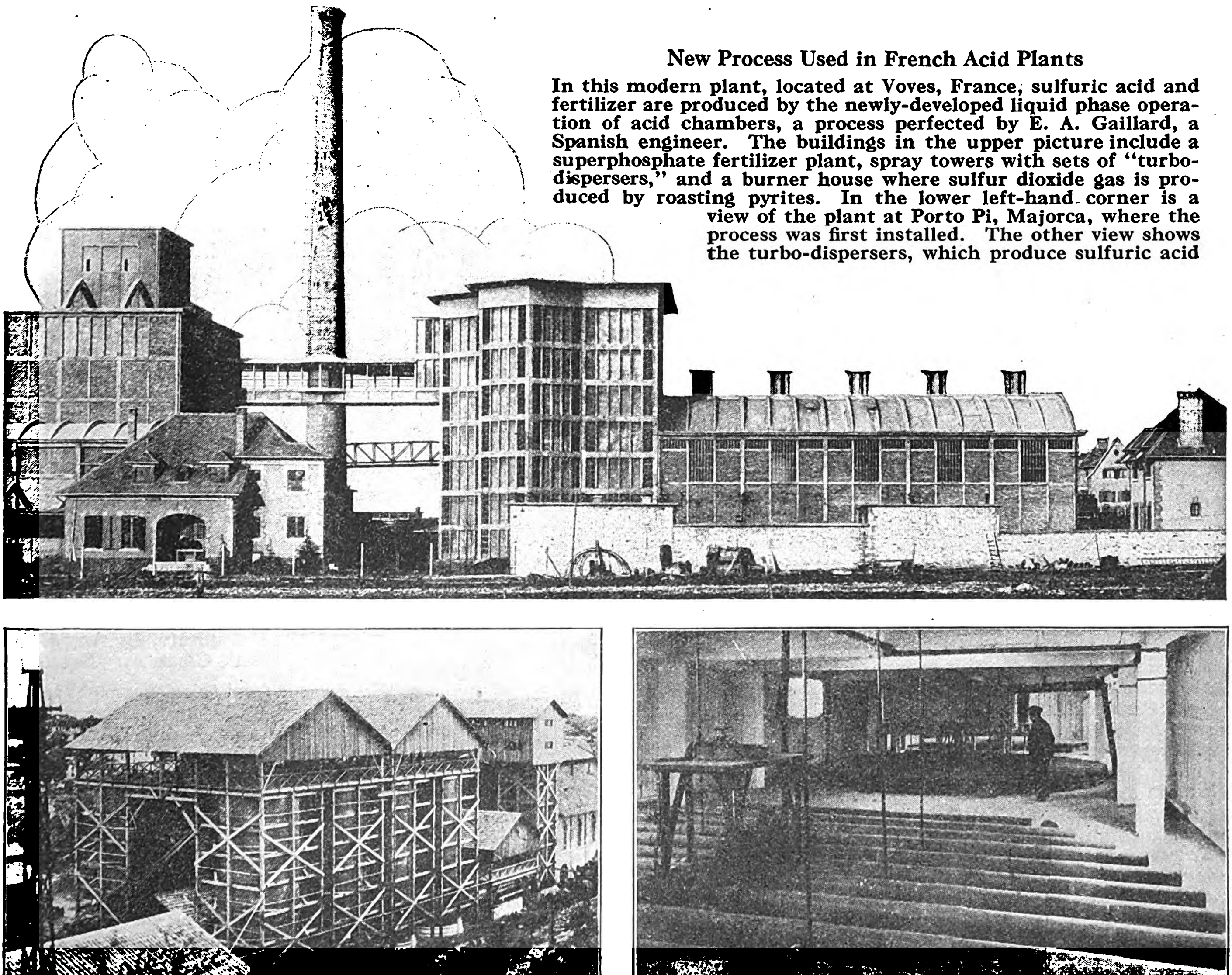
CLARENCE W. LIEB and Edward Tolstoi, of the Russell Sage Institute of Pathology, report the effect of an exclusive meat diet on the chemical constituents of the blood in the *Proceedings of the Society for Experimental Biology and Medicine*. The report says in part: "This is a preliminary report of an experiment to study the effect on human beings of an exclusive meat diet of several months' duration. Our subjects were two Arctic explorers who had spent many years within the Arctic Circle, and who, while there, had lived for the greater part of the time on a practically 100 percent meat-and-fat diet. Preliminary to our observations they were given careful physical surveys. Both were in excellent condition and showed no evidence of impaired health. Following these examinations, studies were made of the respiratory exchange, ketogenesis, protein balance, mineral metabolism, fecal bacteriology, hematology, and the chemistry of the blood. This report confines itself to the blood chemical findings.

"The data may be summarized as follows: (1) Two healthy men who had lived exclusively on meat for eleven months, felt no untoward effects, maintained their weight, and were in excellent health. (2) We find no evidence of renal impairment. (3) The chemical composition of the blood is little affected, except for a slight increase in uric acid and a temporary lipemia. The latter occurred significantly and only after unusual amounts of fat were taken."

Improvements Modernize Sulfuric Acid Manufacture

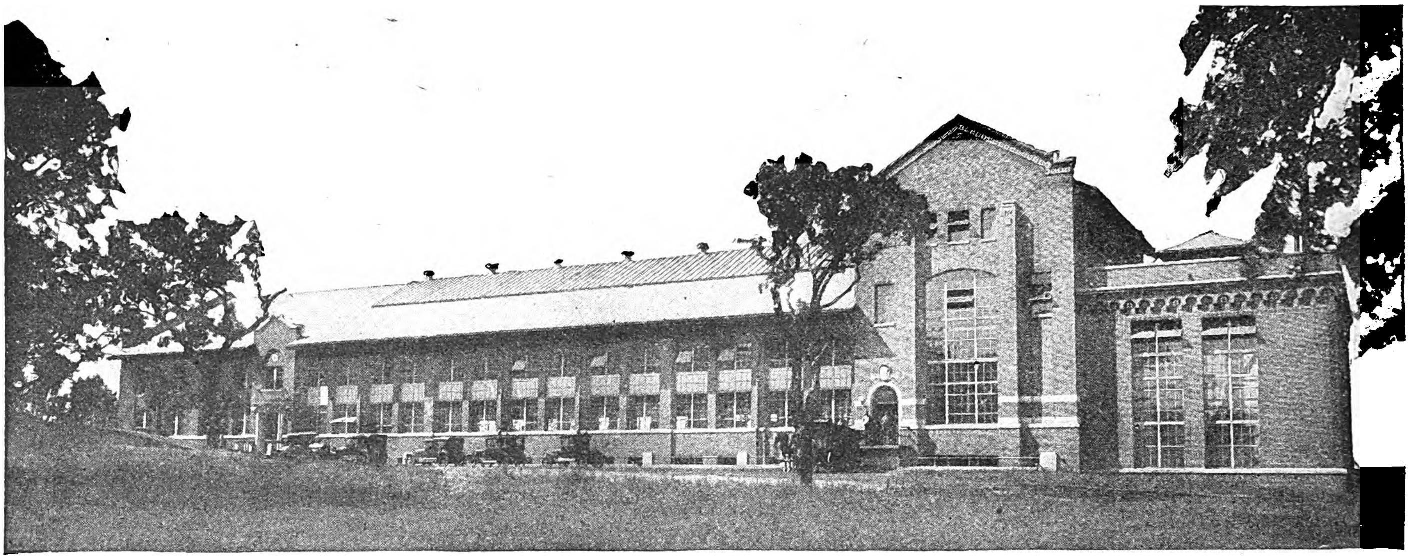
SULFURIC acid has long held its position as a key chemical, that is, it enters into practically every chemical process at some stage of the game. The acid is manufactured by two processes, known as the "contact" and the "lead chamber" process, the former being more economical for the production of concentrated acid (above 60 degrees, Baumé) and the latter holding its precedence for the more dilute grades, used largely in fertilizer manufacture. Improvements in the first, or catalytic process, have been made. Now comes a most interesting development in the older chamber process, which indicates that it is keeping abreast of technical development and holding its own in the production of this vitally important chemical. Percy Parrish, a London chemical engineer, describes what he calls the "liquid phase operation of sulfuric acid chambers" in a recent issue of *Chemical and Metallurgical Engineering*. Roughly speaking, the distinctive point about this new process is that the sulfur dioxide gas, which is the first step of sulfuric acid manufacture, reacts with liquid acid instead of with other gases to form the desired H_2SO_4.

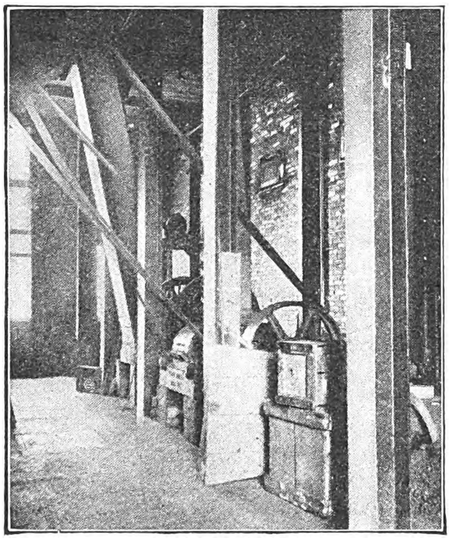
It has been found that when sulfur dioxide gas is forced through liquid nitrous vitriol, which is agitated by known means, the rate of formation of sulfuric acid is abnormally high. This brought the idea of using the principle in acid manufacture, and accordingly, a Spanish engineer, E. A. Gaillard, developed an ingenious device known as a turbo-disperser for atomizing sulfuric acid within closed reaction chambers. Cold acid is projected in the form of a very heavy rain against the internal circumference of a tower chamber, forming a heavy mist which takes



New Process Used in French Acid Plants

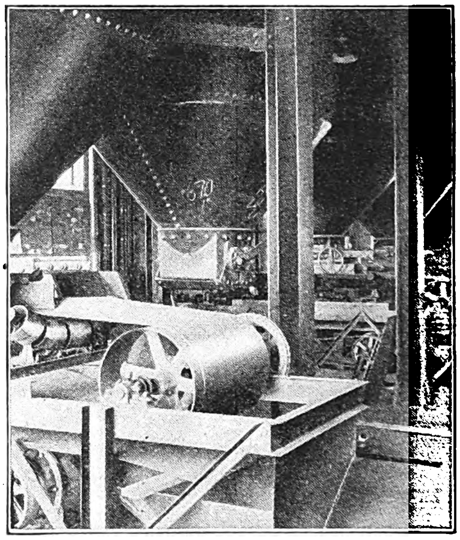
In this modern plant, located at Voves, France, sulfuric acid and fertilizer are produced by the newly-developed liquid phase operation of acid chambers, a process perfected by E. A. Gaillard, a Spanish engineer. The buildings in the upper picture include a superphosphate fertilizer plant, spray towers with sets of "turbo-dispersers," and a burner house where sulfur dioxide gas is produced by roasting pyrites. In the lower left-hand corner is a view of the plant at Porto Pi, Majorca, where the process was first installed. The other view shows the turbo-dispersers, which produce sulfuric acid





Chemical Engineering School

Prospective chemical engineers learn to conduct the important operations practiced in the largest chemical factories at this new experiment station (above), which is a unit of the University of Minnesota. The principles of gravity flow, and proper methods of grinding and crushing materials, are learned by the students using the crusher units shown in the picture at the left. Each unit is fed from storage bins above, and discharges the ground pulp to bins located on the floor below. The belt conveyors, illustrated in the picture at the right, contribute to the future chemical engineer's first-hand knowledge of up-to-date industrial practice. Few commercial plants are as well equipped as this "laboratory" at the University of Minnesota. The new building is to be used as a part of the Mines Experiment Station



up the sulfur dioxide gas much more efficiently than the usual lead-chamber, vapor-phase process.

One of the first plants erected was at Porto Pi, Majorca, in the Mediterranean, shown in the accompanying photographs. It produces 50 tons of 53 degrees Baumé strength acid per day. Other installations have followed, establishing the efficiency of this radically new development in one of the oldest of chemical processes.

Nutritive Value of Iodine

IODINE, as commonly recognized, is not recommended as an item of diet, for in the "tincture" form, or alcoholic solution, it is distinctly unhealthy. In combination with other elements, and in strictly limited doses, however, iodine has beneficial effects on the human system which can not be ignored in the light of recent research.

Drs. Orr and Leitch of the Rowett Research Institute in Scotland, have demonstrated that the effect of iodine on plants depends on dosage. The yield of radishes grown in a control plot to which no iodine was applied was 3240 grams per square meter; with an iodine dose of 0.05 grams per square meter the yield was 5400 grams, but with a dose of 0.5 grams per square meter the yield fell again to 4200 grams. In tests with peas grown in culture solution it was found that the addition of iodine to the extent of 0.0001 gram per liter was accompanied by an increase of from 5 to 10 percent in the weight of plants. The addition of 0.001 grams, however is followed by a decrease in weight of about 30 percent, and the toxic effect rapidly increased with increase of concentration of iodine above that level.

Experiments with pigs show that where a small dose of iodine was given, the average gain per pig per day was 1.55 pounds, whereas pigs which had not received the iodine gained 1.37 pounds. But when the dose of iodine was increased, the pigs not receiving the iodine did the better.

Experiments in Switzerland have shown that boys receiving potassium iodide grew on an average of 0.7 centimeter more than untreated boys, and put on 0.2 kilogram more in weight. The treated girls grew on an average of 0.4 centimeter and put on 0.1 kilogram more weight than the untreated girls. It has been found that the mean weight at birth of infants of mothers using iodised salt was about 100 grams higher than of those of not using iodised salt.

White Bread Holds Popularity

THE staff of life is strong enough to hold its place on American tables for some time to come, according to Dr. Walter H. Eddy, in a recent issue of the *Baker's Weekly*. Discussing the use of whole wheat versus white flour, he points out that there is a willing tendency to accept the whole cereal in many forms as a breakfast adjunct. A decided preference for white flour bread persists despite all arguments as to its deficiencies. The development of milk breads is a direct response of manufacturer and consumer to education in regard to white flour deficiencies.

It does not follow, because a foodstuff is not in itself a complete diet, that it is thereby useless or necessarily harmful. Analyses show that graham, entire wheat, or rye breads made with water are all distinctly better sources of iron and phosphorus than white bread made with either water or milk. Tastes differ. White bread may well find a perfectly satisfactory place in a menu in which incomplete foods are properly supplemented.

Tri-sodium Phosphate, By Any Other Name, Won't Clean Any Better

FAR be it from this department to give away valuable trade secrets, but a number of our friends have been surprised and pleased to learn that the wonderful new cleaner they had discovered at the grocers was nothing more than a familiar chemical which had acquired a trick name. According to the United States Tariff Commission, the use of tri-sodium phosphate is rapidly increasing. It is valuable as a water-softener and as an emulsifier of grease. Its widest use is for general household and industrial cleaning, especially where non-abrasive material is desired. For household consumption a large per-

Romance or reality, movie studios or factories ...*there* this *grainless* wood

In moving picture studios the strength and lightness of Masonite Presdwood, combined with its ability to take any finish, make it the chosen material for set building. In industry the same qualities lower production costs and make manufactured articles better. Perhaps you, too, can use it to advantage. May we send you samples to try?

FOR SCENES IN THE MOVIES

A king's palace today—a rustic cottage tomorrow. To Masonite Presdwood, as used in the leading movie studios, it is all in the day's work, for so sturdy is this beautiful grainless wood that moving picture producers find they can use the same pieces again and again—in scene after scene.

But this versatile actor, Presdwood, plays equally important industrial roles. Today a shipment goes to an automobile body plant to be used in motor truck side panels. Tomorrow a carload is routed to another factory where children's toys are being turned out by the thousand. In fact, there seems to be no limit to the wide range of uses for this attractive paneling material. And alert production managers are continually finding new ways to use it in improving their products or lowering the cost of the articles they manufacture.

Unlimited Uses in Industry and Building

Presdwood is used for the ceilings of railway passenger coaches; for the backs of theatre seats, in automobile bodies and speed boat decks and hulls. It makes light, strong, splinterless shipping containers, decorative folding screens, bass and snare drum shells, table tops, kitchen cabinets and many other familiar objects.

FOR PUNCH PRESS OPERATIONS

In building, it is used for interior paneling, for house and office partitions and for the lining of closets, attics or elevator shafts. It is specified for the surfacing of concrete and masonry forms. And because it is easily sawed or cut and does not split, it is ideal for the man at home who puts up shelving or for the mechanic who builds a doll house.

Eliminates Waste and Expense

Since it is free from knots, checks, or cracks, Masonite Presdwood reduces waste and cuts expense to a minimum. And because it is made from natural wood, with no artificial binding material, it cannot possibly harm valuable tools and machinery.

New methods and up-to-the-minute materials will bring profits to your business. Masonite Presdwood is wood in its most modern form.

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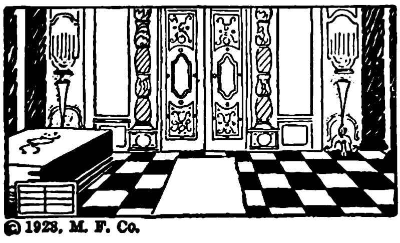

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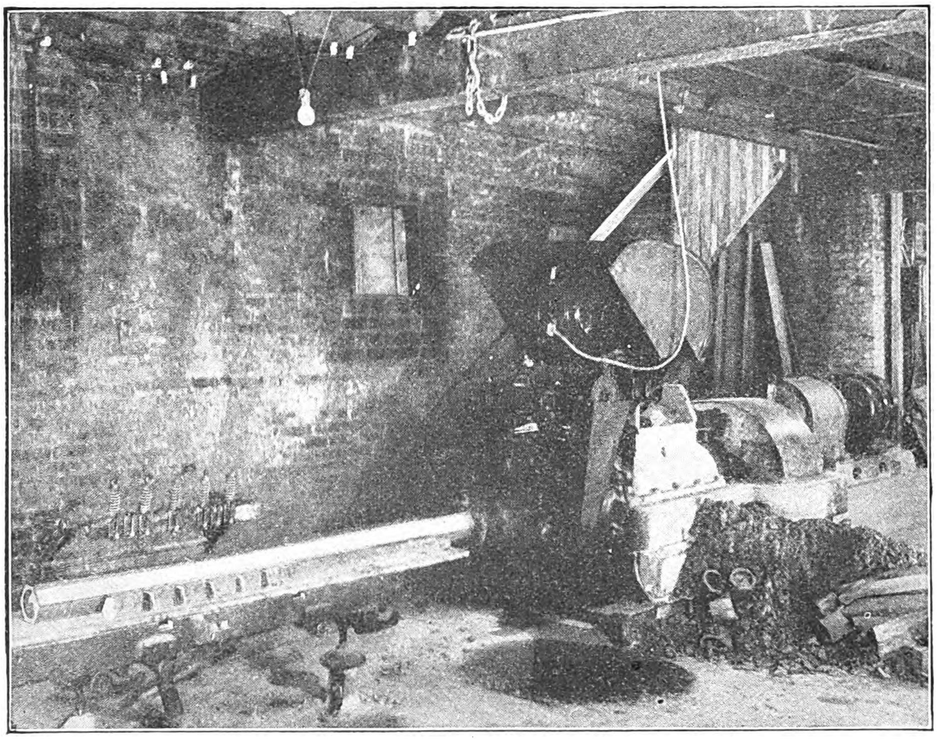
FOR MOTOR TRUCK PANELS

A.B.C. CANDY COMPANY

© 1928, M. F. Co.



This machine extrudes a continuous strip of "hexahelix" blocks, ready to be cut into the proper length and fired. The blocks are used for absorbing gas

centage of the total production is put up in small packages under various trade names. Some of these brands consist of tri-sodium phosphate only; some contain borax, soda ash, and other ingredients. For industrial cleaning, large quantities of tri-sodium phosphate are sold by the barrel to hardware manufacturers, automobile makers, garages, bottling works, restaurants, hotels, packing companies, dairies, and railroad companies.

In laundries, it is used to soften hard water and to remove stains left on goods during previous washings. In the paper industry, considerable quantities of it are used for cleaning felts and as a casein solvent. Minor uses are (1) as an ingredient of boiler compounds to remove boiler scale or to prevent its formation; (2) in the manufacture of tri-calcium phosphate used in tooth pastes and in free-running salt as a stabilizer; and (3) in the preparation of paint removers.

Mineral Pigments to Be Studied

A PROGRAM of investigation which promises to assist in the development of a substantial American industry in a field hitherto largely neglected is the study of the ochers and mineral pigments of this country being conducted by the United States Bureau of Mines. This study, which was first concerned with the ochers and mineral pigments of the Pacific northwest states, is being extended to cover all the known ocher deposits in the country. Co-operation has been obtained from most of the state geological departments, and they are collecting samples and studying the occurrence of the pigments in their respective states.

The value of an ocher depends principally on its color and the closer it approaches the golden yellow hue of the French ocher, the greater is its value. When the original sand and impurities have been removed by washing in water, the ocher should have an impalpable fineness and an iron oxide content of 17 percent or more, and should be able to retain a large portion of its color strength when diluted with zinc oxide.

All interested parties are invited to send one-pound samples of ochers or other pigment materials to the Northwest Experiment Station, United States Bureau of Mines, Seattle, Washington, for preliminary classification tests.

Ingenious Device Improves Absorption Process

MANY chemical processes require the absorption of gas by a liquid. This is generally accomplished by passing the gas up through a tower packed with bricks or "rings" over which the absorbent liquid trickles. The greater the surface of liquid exposed to the gas, the more efficient the absorption process. There has recently been developed a most ingenious "block" for use as a tower packing which provides an absorption surface far in excess of ordinary packing. This block is a hollow-hexagonal prism, through the center of which runs a spiral passage. The block was designed primarily for acid absorption and is made of high-grade clay which produces an acid-proof block.

Ingenious as is the block itself, it is equalled by the machine which extrudes this complicated form in a continuous strip, all ready to be cut to length and fired. The "hexahelix" block is being manufactured by Maurice A. Knight of Akron, Ohio.

Catalyzing the Poison That Would Poison the Catalyst

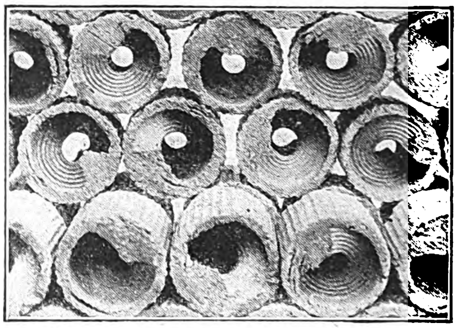
REFERENCE has been made often, in these columns, to the chemical phenomenon of catalysis. The chemist explains it by saying that the substance called the catalyst speeds up the reaction between two substances, without itself being affected. To the layman, however (who probably knows almost as much about it after all) it appears that this stuff called the catalyst is a sort of magic wand which somehow transforms one or more gases into a totally different substance by simple contact.

Unfortunately, there are too often foreign substances present which spoil the whole trick by casting a spell over the magic wand or, as the prosaic chemist would say, by poisoning the catalyst. Thus the newer catalytic processes such as the synthesis of ammonia, synthesis of menthanol from water gas, and synthesis of petroleum from water gas, require the complete removal of sulfur compounds from the gases used. Even traces of organic sulfur compounds, which would be entirely unimportant when the gas is used as a fuel, are sufficient to destroy the catalysts used in these processes. Hydrogen sulfide may be satisfactorily removed on an industrial scale by well-known methods.

The only satisfactory process for removal of organic sulfur to the required extent, which has been used on an industrial scale, in this country at least, involves liquefaction of the gas at low temperatures. It is desirable, however, to have a cheaper method. Consequently, the Pittsburgh Experiment Station of the United States Bureau of Mines is starting an investigation of this problem. It has been claimed by Franz Fischer of Germany that organic sulfur compounds may be completely converted to hydrogen sulfide at relatively low temperatures when the gas is passed over appropriate catalysts at relatively low temperatures and in the presence of hydrogen.

Copper Traces in Tap Water Not Poisonous

THE question as to whether or not the amounts of copper found in our food and drinking water have any ill effects on the human organs, causing chronic diseases, is of importance because of the widespread use of copper and its alloys in the commercial manufacture of foods. Early investigators have not been uniform in their opinions, but the weight of evidence was that copper was not a harmful substance in the amounts ordinarily to be found in food and in drinking water.



These hollow acid-proof clay "blocks" have a spiral passage which provides increased surface for absorption of gas by a liquid

Several years ago Dr. Mallory, eminent pathologist of the Boston City Hospital, announced that copper might by the underlying cause of cirrhosis of the liver, termed hemochromatosis. This conclusion was based upon a sudden increase in the number of autopsies showing the pathologic lesion. Practically all were of individuals who had been drinking post-war alcoholic beverages. Samples of bootleg liquors sold in Boston contained copper in larger amounts than

(*Please turn to page* 467)

, , , and so to bed , , , late , , , too much supper , , , wish I could get to sleep , , , bad dreams , , , business worries , , , dog barks , , , baby cries , , , time to get up , , , jangled nerves , , , irritable skin.

—*then* is the time your skin
needs the comfort of a fresh Gillette Blade

THE NEW FIFTY-BOX
Fifty fresh double-edged Gillette Blades (10 Packets of fives) in a colorful chest that will serve you afterward as a sturdy button box, cigarette box or jewel case . . . Ideal as a gift, too. Five dollars at your dealer's.

THERE are mornings when a fresh Gillette Blade is better than any pick-me-up you can name.

And there are mornings when your beard is as tough and blue as your state of mind; when the hot water faucet runs cold and your shaving cream is down to the last squeeze and you scarcely have time to lather anyway; mornings when all the cards seem stacked against your Gillette. But slip in a fresh blade. Enjoy the same smooth, clean shave that you get on the finest morning.

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There you see some $12,000,000 worth of machinery invented and improved continuously for twenty-five years for just one purpose: to make the Gillette Blade—*every* Gillette Blade—do its smooth, expert job *every* morning for the thirty million Americans who count on it.

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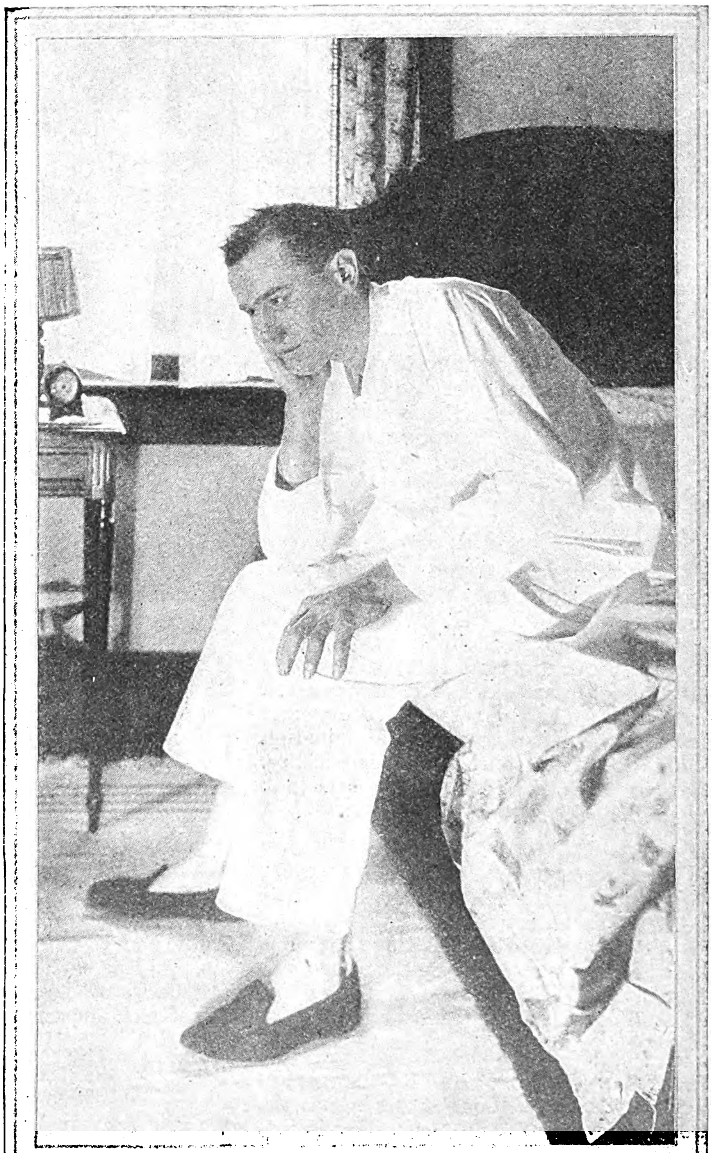
★ ★ ★ **Gillette** Gillette



Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Miscellaneous

OPERATING COST STATISTICS OF AUTOMOBILES AND TRUCKS, Bulletin No. 91, presents to the owner or operator of motor vehicles valuable statistics regarding operating expenses. The data were compiled from a study of cost records on approximately 800 automobiles and 900 trucks, most of the information being supplied by state highway departments, fleet operators, and individuals operating their own cars or trucks. *Engineering Experiment Station, Iowa State College, Ames, Iowa.—Gratis.*

THE RURAL JUNIOR HIGH SCHOOL, Bulletin No. 28, of the Bureau of Education, is a study of the problems and experiments associated with the extension of the junior high school to rural communities. *U. S. Government Printing Office, Washington, D. C.—15 cents.*

ATLAS OF COMMERCIAL WOODS OF THE UNITED STATES, by Dr. H. P. Brown, is featured by 60 plates illustrating the structure of various commercial timbers. "There is no mystery about wood identification," according to Dr. Brown. "Anyone can readily learn to recognize our common timbers if he will but train his powers of observation." *Extension Department, New York State College of Forestry, Syracuse, N. Y.—Two dollars (bound or loose-leaf).*

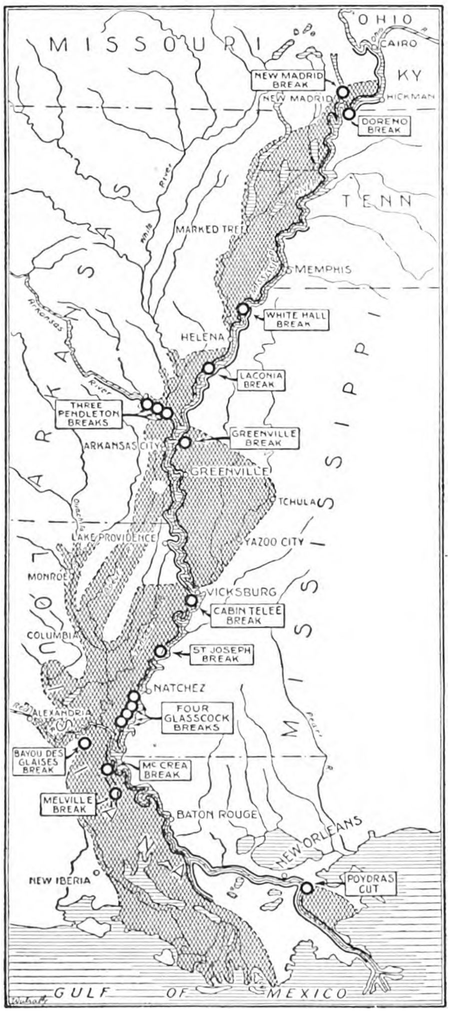
PRESENT HOME FINANCING METHODS is a 23-page paper published by the Bureau of Standards, outlining the facilities available to borrowers in financing the purchase of homes. *Superintendent of Documents, United States Government Printing Office, Washington, D. C.—Five cents.*

RELATION OF ILLUMINATION TO OCULAR EFFICIENCY AND OCULAR FATIGUE, Public Health Bulletin No. 181, gives the results of a study made in the main post office in Chicago from 1924 to 1926, to test the effect of different degrees of illumination on clerks. The increased efficiency and decreased ocular fatigue when illumination is increased is of considerable significance. *Surgeon General, U. S. Public Health Service, Washington, D. C.—Gratis.*

PUBLIC AQUARIUM, ITS CONSTRUCTION, EQUIPMENT, AND MANAGEMENT, Document No. 1045, is an interesting explanation of the various modes of constructing aquariums and the most successful methods of management. *U. S. Government Printing Office, Washington, D. C.—25 cents.*

PRACTICAL ASPECTS OF RESUSCITATION is a well illustrated booklet describing the causes and treatment for asphyxiation, with practical guidance as to the use of the Schaefer method and the H-H Carbogen Inhalator in cases of emergency where natural respiration has stopped and can be restored by artificial respiration. *Mine Safety Appliances Company, Pittsburgh, Pa.—Gratis.*

PLAN OR PERISH and WASTE FROM MISSISSIPPI MUD, by J. Russell Smith, are reprints of two thought-provoking articles, one of which was awarded the Harmon prize as the best magazine article of the year. Dr. Smith, who is Professor of Economic Geography at Columbia University, firmly and clearly states his opinion that the problem of the Mississippi floods can best be solved by the plan that has kept Egypt rich for thousands of years. *The John C. Winston Company, Winston Building, Philadelphia, Pa.—Gratis.*



Courtesy New York Times

The 18,000 miles flooded last year when levees failed to do their duty

WATER POWER RESOURCES OF CANADA is a well prepared annual review of the developed and undeveloped water power of the various Canadian provinces. Statistics are given showing the use of water power in the pulp, paper, and other industries, with a comparison of the coal equivalent. *Director, Dominion Water Power and Reclamation Service, Ottawa, Canada.—Gratis.*

Aeronautics

SOUNDPROOFING OF AIRPLANE CABINS is the first report of an investigation which is being carried out by the Bureau of Standards for the Aeronautics Branch of the Department of Commerce. The paper indicates that construction of the cabin walls in layers is the most practical way to obtain a reasonable degree of quiet without excessive weight, taking all factors of the problem of noise reduction into consideration. *Bureau of Standards, Department of Commerce, Washington, D. C.—Gratis.*

BIBLIOGRAPHY OF AERONAUTICS FOR 1927 covers the aeronautical literature published during the year, both in the United States and in foreign countries. The material is listed in dictionary form with author and subject entry, with sufficient cross reference for research in special lines. *U. S. Government Printing Office, Washington, D. C.—35 cents.*

Agriculture

WORLD SURVEY OF THE LIVE-STOCK INDUSTRY, a pamphlet summarizing the results of a survey undertaken by the Bureau of Animal Industry, covers the activities of 33 countries with respect to live-stock improvement and outlines the principal methods in use, together with results obtained. *Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C.—Gratis.*

ARTIFICIAL RIPENING OF FRUITS AND VEGETABLES is a 35-page bulletin with numerous illustrations and several color plates, discussing the ways of artificially ripening many kinds of fruit and vegetables. The bulletin includes a good bibliography on the subject. *Agricultural Experiment Station, University of Minnesota, St. Paul, Minn.—Gratis.*

GROWING RYE IN THE WESTERN HALF OF THE UNITED STATES is a recent farmers' bulletin published by the Department of Agriculture. *U. S. Government Printing Office, Washington, D. C.—Five cents.*

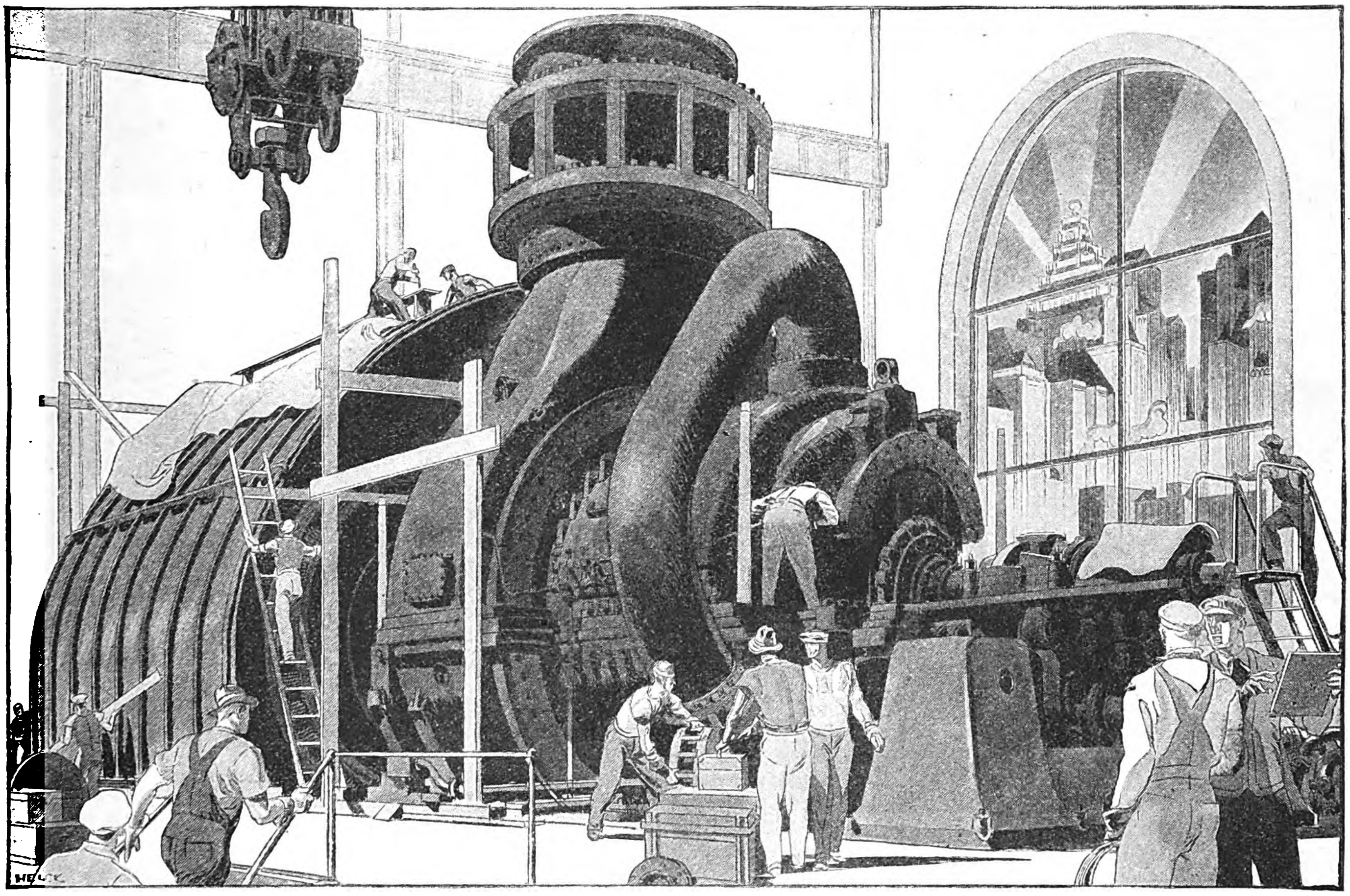
Coal

FALLS OF ROOF IN BITUMINOUS COAL MINES: INFLUENCE OF SEASONS AND RATE

(Please turn to page 472)

SPEEDING THE WORLD'S WORK

DRAWN FOR WESTINGHOUSE BY C. PETER HELCK



THE WORLD'S LARGEST STEAM TURBINE-GENERATOR—BUILT BY WESTINGHOUSE. INSTALLED AT HELL GATE STATION, NEW YORK CITY, FOR THE UNITED ELECTRIC LIGHT & POWER COMPANY—EDISON-UNITED SYSTEM.

Light for a million homes

Imagine a city of a million homes. It is night, and light is streaming from countless windows. Capacity great enough to light all these homes at one time has been built into a single gigantic Westinghouse steam turbine-generator unit.

Yet size alone does not measure the progress which this turbine represents. Far more important than bulk is the standard of efficiency in modern power-producing equipment of which this great machine is an outstanding example.

Ten years ago it was not uncommon for electric light and power companies to develop only one kilowatt-hour of electrical energy for every four pounds of coal burned beneath their boilers. Today, Westinghouse turbines and other power-producing equipment help public utility management to treble its output of energy per pound of coal.

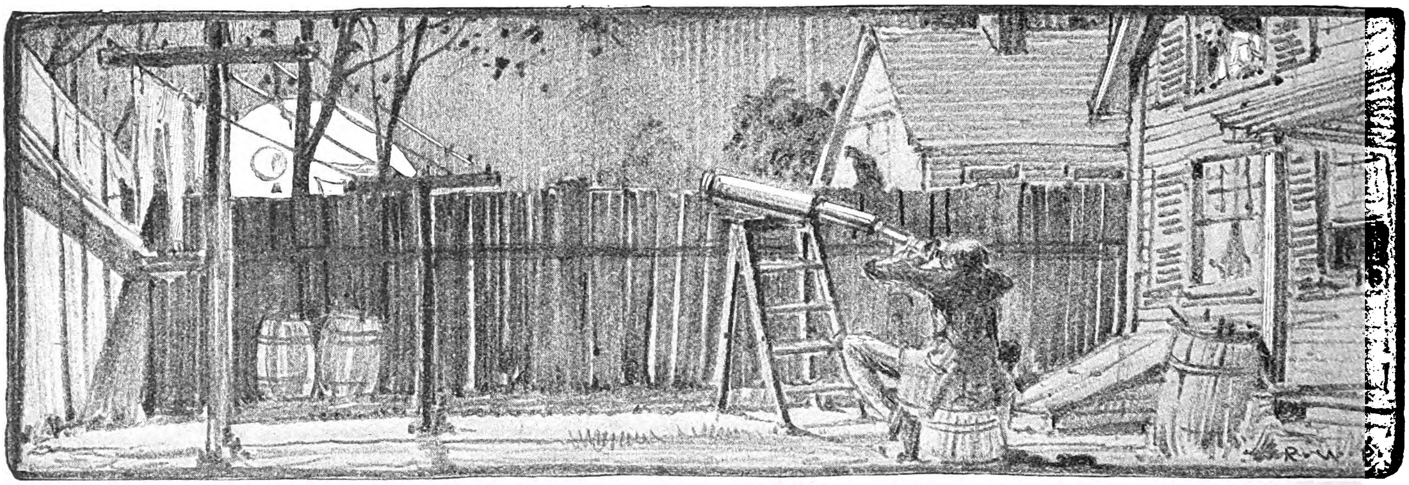
Here you have one reason why the average price of electricity today is lower than before the war, although the prices of most other things are higher.

Contributions of Westinghouse to more effective power production range from the largest turbines to the smallest, not merely for electric light and power companies but also for industry, mines and ships. They include auxiliary equipment for turbine installations, from stokers to every class of generating and distributing equipment. Westinghouse apparatus also includes the lighting units and motors which make electricity serve the everyday needs of home and industry. From the source of electrical power to its ultimate application in serving modern needs Westinghouse responsibility runs the entire course.

Westinghouse Electrification
Appliances Apparatus
Wiring
WESTINGHOUSE ELECTRIC

The Sign of a Westinghouse Dealer

Westinghouse



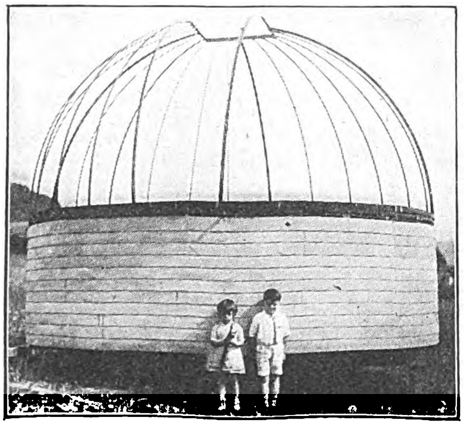
The Back Yard Astronomer

HOW to make a neat, serviceable, light weight observatory without spending too much hard earned cash is a problem which has vexed many amateurs. Mr. R. W. Steber of the F. A. Steber Company, cigar manufacturers, Warren, Pa., has solved this problem. Incidentally he has made a 16⅝-inch telescope—one of the largest telescopes thus far made by means of the instructions in the book "Amateur Telescope Making." The entire space in this month's issue will be devoted to Mr. Steber's description, contained in a letter he was requested to write.

"The observatory," he states, "is 16 feet in diameter. Its side walls are 48 inches high. For a foundation we put down four six by six-inch chestnut posts, below the frost line. Next the post for the telescope was put in. This is a six-inch, steel well casing, set about six feet into concrete, and off center enough to allow for the overhang of the polar axis. The floor of the observatory was then built up on two-by-sixes, with the flooring laid diagonally for rigidity. Clearance was allowed around the post, to obviate vibration.

"On a 16-foot circle two-by-fours were placed at two foot intervals. These were braced plumb, and on them on the inside, was put a two-inch angle iron with the leg down. Through this a lag screw was driven into each post, making the whole very rigid. All angles throughout the whole job were rolled on an eight-foot radius. This simplifies things a great deal.

"We then sided the structure with regular six-inch weather boarding, which had the lower inside edge rabbited out so that the siding would fit the strip beneath, and prevent the ends from pulling up when laid on a circle. This is one theory which distinguished itself by coming up to expectations.



The observatory ready for roofing

"For the lower track we used a two-inch angle iron with leg turned up on the outside, screwed to the top of the uprights and screws countersunk to give a smooth track. The upper track is a one and one half inch angle iron, with a three quarter inch angle spot-welded to its under, inner edge, to make a race for the balls.

"Steel balls apparently are very expensive, even if 'seconds' are used, so we had the balls turned out of maple and then soaked them in linseed oil for a few days. All were heavily coated with grease and then put into place. Between the balls are sticks of wood about two feet long, cut as segments of a 16-foot circle, to act as spacers.

"For the dome, we made the opening of one and one half inch angle iron, with a flat top. The lower end is bolted into the upper track. The material used was just light enough so that we could punch out the holes with a large hand punch. After the frame of the opening was in place we bolted in the ribs, which are three quarter inch angle iron, leg side down. The upper or flat side of the angle was then punched in three or four places and slats of wood screwed on it. To these slats the canvas covering was tacked.

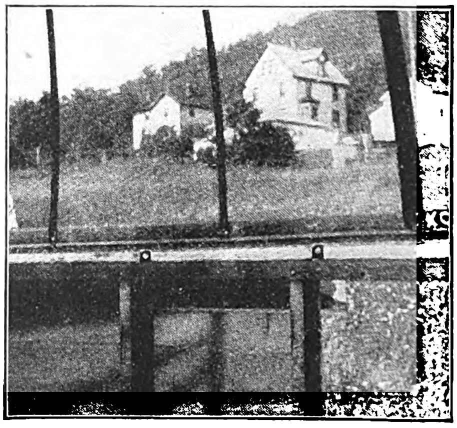
"In putting on the canvas, we started at the opening, which has a lateral brace at the bottom, and stretched the canvas over the adjoining rib, holding the rib in place by putting a couple of sticks between it and the opening; and so on, around, until we reached the other side of the opening. The wooden braces were then knocked out and the dome held its shape. This makes a remarkably rigid dome, and not too heavy for one person to handle. The canvas was painted at once with about 50 pounds of white lead and four gallons of linseed oil. On the first painting the canvas takes up all the oil it will hold. This makes it a perfectly watertight, neat, light dome.

"Along the sides of the irons forming the opening, we bolted on a wooden coaming about three inches high, and then made a strip of canvas four inches wider than the opening, sewing a flexible wire into the sides of the canvas, and a heavy roller across the bottom. There is also an occasional light wooden strip tacked across its width, to act as a spreader and to help bear the weight of snow and ice in the winter. Then, with a rigging very similar to what is used on a roller awning, we roll up the canvas out of the way at the top of the dome; and when finished, roll it down very quickly, stretching it tight so that the sides of the canvas come down over the coaming, making it storm proof.

"The telescope itself has a 16⅝-inch mirror of 125½ inches focal length. The tube is of 16-gage steel, allowing a three quarter inch air space along the sides. The cell is of the conventional type. The finder is a two and five eighth inch doublet, 16-inch e.f.l., with cross hairs in the field.

"For the axes, Ford axles were used. The housing at the brake end was machined off, and a 194-tooth gear bolted into this, and against the gear rests a slip plate which acts as a clutch. Through this plate run three heavy adjusting studs over springs for regulating the pressure of the plate on the gear, and thus the amount of drag or slip between the ring and the axle. In this way, we swing easily to any position, and at once pick it up in slow motion. As the tube and fittings weigh several hundred pounds it is necessary to have this very accurately fitted for use with high powers.

"The declination axis has a rod running from the gear to an easy position at the eyepiece. The declination lock is another rod, parallel to the first, running through the brake-band housing and screwing



Wooden ball-bearings and spacers

"More dramatic than drama, more interesting than fiction."—*Birmingham News.*

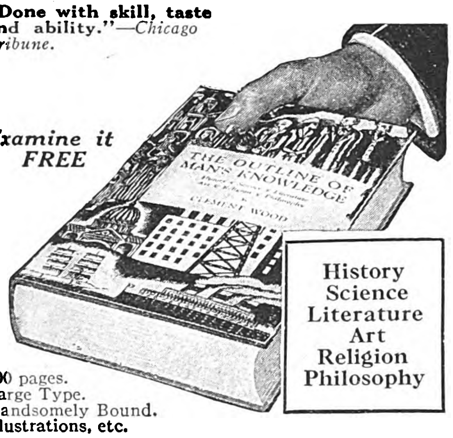
"A university in itself." —*Pittsburgh Sun-Telegraph*

"Done with skill, taste and ability."—*Chicago Tribune.*

"The ONE book to read and know."—*Philadelphia Public Ledger.*

"Like viewing the universe from a hilltop."—*Toledo Times.*

Examine it FREE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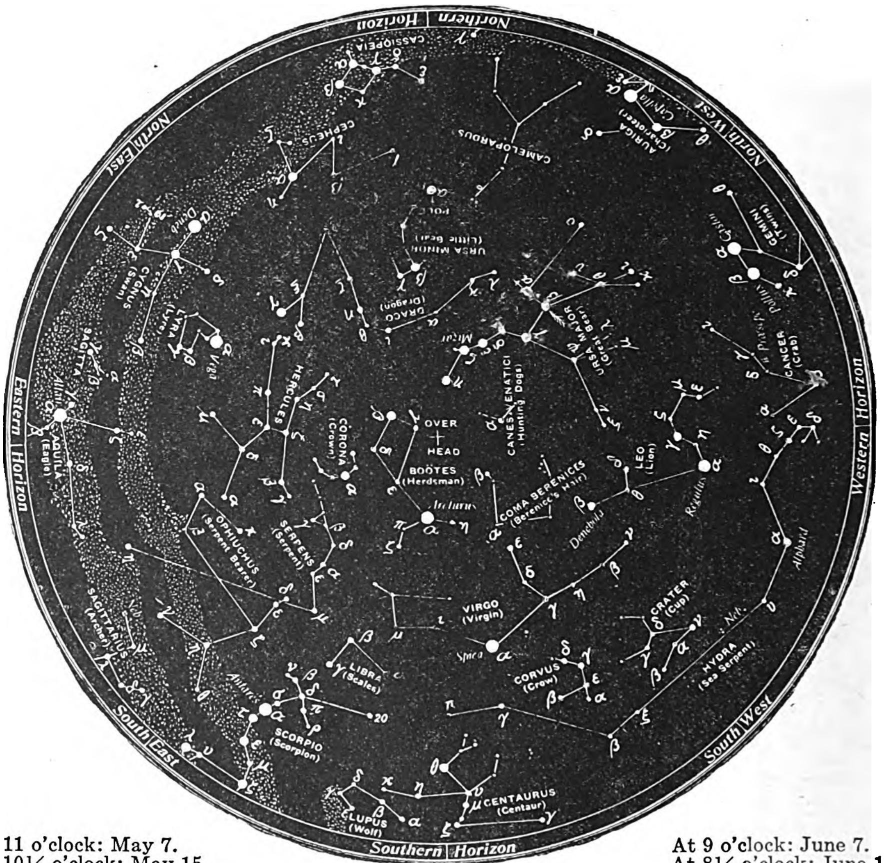
trohelioscopes are requested to keep in touch with telescope editor, who quite naturally takes an interest in the work of other amateurs.

Don't miss the article on another page, describing Hamilton's large reflector. We have on hand several descriptions of rather unusual jobs, and these will be published in due course. It is thought that many other jobs have not been reported for publication. Don't hide your light under a bushel, fellow amateurs.

Amateurs who definitely plan to make Cassegrainians will receive information to their advantage on communicating with *A. G. I., Tel. Ed.*

The Heavens in May

By PROF. HENRY NORRIS RUSSELL, Ph.D.


Northern Horizon
North West
Western Horizon
South West
Southern Horizon
South East
Eastern Horizon
North East
CASSIOPEIA
CEPHEUS
CAMELOPARDUS
AURIGA (Charioteer)
Capella
GEMINI (Twins)
Castor
Pollux
Polaris
URSA MINOR (Little Bear)
DRACO (Dragon)
CYGNUS (Swan)
Deneb
LYRA (Lyre)
Vega
URSA MAJOR (Great Bear)
Mizar
CANCER (Crab)
Praesepe
CANES VENATICI (Hunting Dogs)
HERCULES
CORONA (Crown)
OVER HEAD
BOOTES (Herdsman)
Arcturus
COMA BERENICES (Berenice's Hair)
LEO (Lion)
Denebola
Regulus
SAGITTA
AQUILA (Eagle)
Altair
OPHIUCHUS (Serpent Bearer)
SERPENS (Serpent)
VIRGO (Virgin)
Spica
CRATER (Cup)
HYDRA (Sea Serpent)
Alphard
SAGITTARIUS (Archer)
LIBRA (Scales)
CORVUS (Crow)
Antares
SCORPIO (Scorpion)
CENTAURUS (Centaur)
LUPUS (Wolf)

At 11 o'clock: May 7.
At 10½ o'clock: May 15.
At 10 o'clock: May 22.
At 9½ o'clock: May 30.
At 9 o'clock: June 7.
At 8½ o'clock: June 14.
At 8 o'clock: June 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on May 7, etc.

NIGHT SKY: MAY AND JUNE

MERCURY is an evening star and should be easily seen about the time of his greatest elongation, which comes on the 15th, as he is far north and does not set till 9 P.M.

Venus has passed into the morning sky and is conspicuous there, especially toward the end of the month, when she rises before 3 A.M. With the telescope she appears as a crescent, growing broader but smaller in diameter as time passes.

Mars is an evening star in Cancer, but remains in sight till nearly midnight. He is more than 150,000,000 miles away by this time and is but a little brighter than a second magnitude star.

Jupiter is in conjunction with the sun on the 14th and is invisible this month.

Saturn is in the opposite quarter of the heavens and rises between 9 and 10 P.M. Uranus is a morning star, rising about 3 A.M., while Neptune, which is in quadrature on the 20th, is visible in the evening.

The moon is in her last quarter at 8 P.M. on the 1st; new at 1 A.M. on the 9th; in her first quarter at 4 P.M. on the 15th, full at 8 A.M. on the 23rd, and in her last quarter for the second time at 11 A.M. on the 31st. She is nearest the earth on the 11th and farthest away from the earth on the 26th.

At this new moon, there is an eclipse of the sun which, since she is near perigee, is total and of a long duration—five minutes at maximum. The shadow track starts in the Indian Ocean, south of Madagascar, and sweeps far across the sea before it comes to land in northern Sumatra and the Malay Peninsula. After another long traverse of the China Sea it passes over the central part of the Philippines, to lose itself in the expanses of the Pacific. This is an important eclipse, although weather conditions are unfortunately none too favorable, and several parties are on their way to the countries which we have named.

There is still a great deal to do in the way of eclipse observation, especially upon the spectra of the solar atmosphere and the corona, and we may hope for much of interest if the sky favors.

The remaining events of the month are unimportant—conjunctions of the moon with Uranus on the 6th, Venus on the 7th, Jupiter on the 9th, Mercury on the 10th, Mars on the 14th, Neptune on the 15th, and Saturn on the 25th. Jupiter is four degrees east of the sun at the time of the eclipse and should add to the spectacle.

Industries from Atoms

(*Continued from page* 460)

had been suspected and it was felt that it had been dissolved from the copper coils during distilling of the crude liquors.

This finding was so contrary to the general consensus of investigators that the Departments of Industrial Hygiene and Pathology of Columbia University jointly reopened the whole question of the effects of copper on the human system. Extensive experiments have convinced the scientists that the quantities of copper that are found in food and drinking water will not injure any human organ. In fact the evidence accumulating shows that small amounts have a beneficial effect on the blood in cases of anemia.

Chromium Plate Adds to Its Conquest

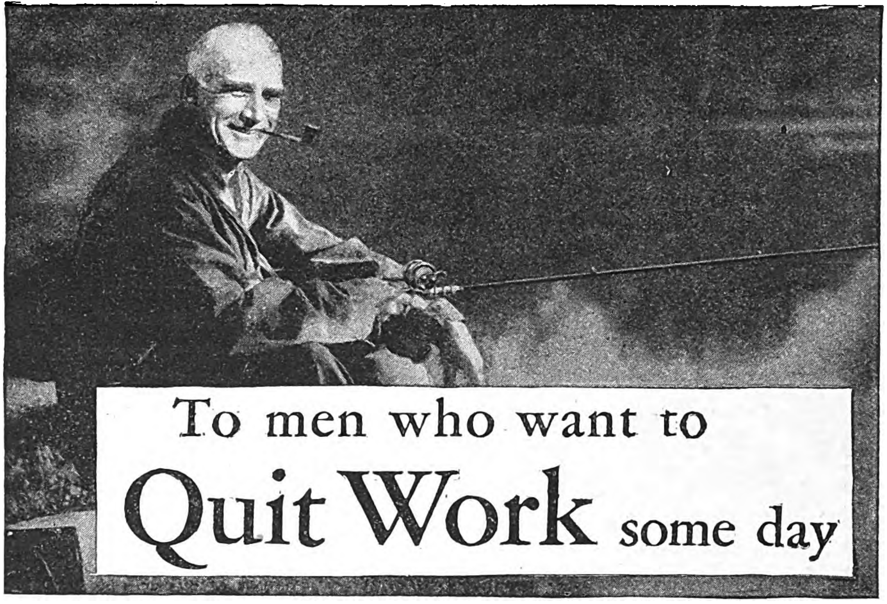
CHROMIUM plating, having taken by storm the radiator shells, bumpers, and other "bright parts" of our automobiles, now creeps behind the head-light lens and spreads itself over the reflector. The fact that it does not dull as quickly as nickel plate is sufficient justification for its triumph, but refined scientific investigation has revealed the additional information that a chromium plated surface possesses unique light-reflecting properties. Two scientists of the United States Bureau of Standards, W. W. Coblentz and R. Stair, have conducted a most interesting study of the reflecting power of nickel, silver, chromium, beryllium and several other metals, revealing the inherent peculiarities of each in reflecting light waves of various lengths.

The results of this work, reported in the *Bureau of Standards Journal of Research* disclose the ability of various polished metal surfaces to reflect light waves, not only in the range of the visible spectrum, but on both the infra-red and the ultra-violet sides. Data are presented on the ultra-violet reflecting power of various metals—beryllium, chromium, cobalt, nickel, silver, speculum, stellite, and stainless steel. For chromium and beryllium the observations extend into the infra-red.

The observations show that contrary to the general experience with other metals, beryllium has a high reflectivity at 250 millimicrons in the ultra-violet, followed by an appreciably lower reflectivity with a minimum at about 400 millimicrons in the visible spectrum.

Chromium has a higher reflectivity than nickel in the ultra-violet and is, therefore, the more efficient as a reflector of ultra-violet radiation. The reflectivity of chromium is conspicuous for its relatively high maximum (70 percent) at 425 millimicrons followed by a wide flat minimum which extends from about 600 millimicrons in the orange to wavelengths beyond 2000 millimicrons in the infra-red.

Another interesting fact disclosed by this study is that the "dulling" or disintegration of metal mirrors is accelerated by ultra-violet light. To test the resistance of chromium plate to such action, a chromium mirror was exposed at a distance of 15 centimeters, for 30 hours to the total radiation from a 110-volt Cooper-Hewitt quartz mercury-arc lamp. The effect of ultra-violet radiation in decreasing the reflecting power of chromium is most marked for wavelengths less than 300 millimicrons, the decrease at 254 millimicrons being from



To men who want to
Quit Work some day

THIS PAGE is addressed to those thousands of earnest, hard-working men who want to take things easier some day.

It tells how these men, by following a simple, definite plan, can provide for themselves in later years *a guaranteed income they cannot outlive.*

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It doesn't matter whether your present income is large or merely average. It doesn't matter whether you are making fifty dollars a week or five hundred. If you follow this plan you will some day have an income upon which to retire.

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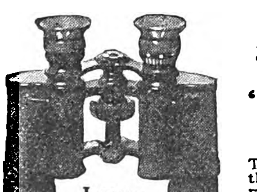

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64 to 59 percent. For wavelengths greater than 300 millimicrons, the reflecting power curve of this sample after exposure was about 1 percent lower than that of the unexposed sample, and practically coincident with the reflectivity curve of the unexposed sample. From this it appears that ultra-violet radiation has but little effect upon the disintegration and consequent lowering of the ultra-violet reflecting power of chromium.

Study Effects of Perspiration on Dyes

"YES, miss, this color is guaranteed fast unless you wear it when you are all tired out." By a stretch of fancy one can imagine the clerk thus warning the purchaser of a brightly dyed gown, if current investigation reveals the expected data on the effect of perspiration on the permanence of aniline colors. Fatigue, certain diseases, and some unusual occupations are believed so to change the chemical composition of perspiration as to react differently on dyed fabrics.

Dr. S. G. Barker, director of research at Torridon, Headingley, Leeds, the headquarters of the British Research Association for the Woolen and Worsted Industries, states that no definite knowledge of the chemical constitution of perspiration is available; neither is there any knowledge regarding the action of the atmosphere on perspiration after it has been exuded from the body. Further, it is unknown whether a normal person exudes alkaline or acid perspiration, many cases of both types having been found.

People of a tubercular type, those engaged in mines or in specific occupations exude perspiration which is quite different in character from that of other persons. Investigations are being made of normal and abnormal perspiration produced under a variety of conditions, such as after excessive manual labor, fatigue, during athletic performances, or in artificially reproduced atmospheres, such as would be produced in various baths. It is planned to extend the tests to people suffering from a variety of complaints, such as rheumatism, et cetera, where perspiration has a very definite meaning. As a result of this work, it is hoped that it will be possible to place the manufacturer in a position to give a test to his fabrics, so that the hosiery trade particularly will know the precise effect of perspiration not only on the dye stuff, but on the fabric itself.

Prevents Peanut Butter from Sticking in Mouth

EVEN those fond of peanut-butter must admit that it displays a pernicious habit of sticking to the teeth, gumming up the entire masticating equipment and making one feel like a dog which has just started to chew on a caramel. This tendency of an otherwise admirable delicacy is due to the fact that the paste produced by grinding the nuts is dry.

Donald W. Howe, of Biloxi, Mississippi, has just come forward with a boon to myriad molars by inventing a way to eliminate the stickiness of peanut butter by incorporating in it a powdered material ground fine, presenting a large surface area upon which saliva may act. A large variety of substances may be used for this purpose, such as powdered fruit juices; dextrins; proteins; sodium, potassium, and ammonium salts of acids, such as the chlorides,

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sulfates, tartrates, citrates, lactates, and acetates. The higher the solubility of the incorporated powder, the greater its effect in reducing the clogging effect in the mouth.

New Aluminum Solder

A NEW aluminum solder known as "Soldalume" has been announced by the Aluminum Solder Corporation of America, 730 Fifth Avenue, New York, N. Y. The solder consists of a white powder which is melted at a temperature of 350 to 400 degrees, Fahrenheit, by heat applied to the metal at a point adjacent to the joint to be made. It is said that a temperature of 800 degrees, Fahrenheit, is required to destroy the joint. Tests are reported to have shown a tensile strength of 12,000 pounds per square inch for aluminum-to-aluminum butt joints, and 30,000 pounds for duralumin butt joints.

New Products Enter Baking Powder and Plastic Fields

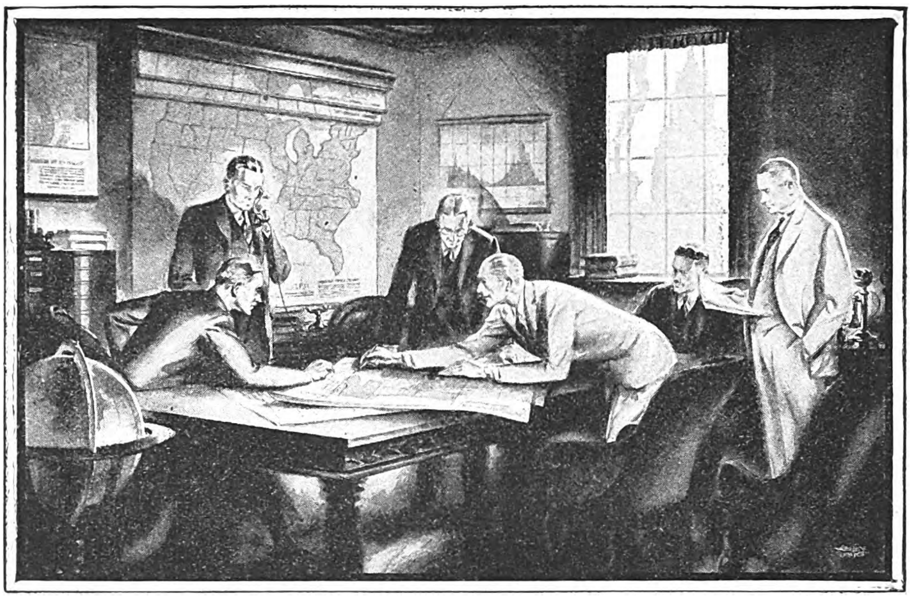
ADIPIC acid, known as adipinic acid in Germany, and its derivatives, have recently become products of more general importance, says the Berlin correspondent of *Chemical and Metallurgical Engineering.* The Duetschen Hydrierwerke, which have specialized in the hydrogenation of benzol, napthalene, and homologs, have developed a new process, presumably through the oxidation of one of these products, which now makes these substances available at comparatively low prices. Since extended experiments have shown that the physiological action of adipic acid is harmless, it can be used for many purposes for which tartaric acid has formerly been used; this suggests its use in the baking powder industry, for beverages, for medicinal purposes, et cetera, and the more forcibly since its price is lower than that of tartaric acid.

In the baking powder industry, adipic acid is superior to tartaric acid only to a slight extent, 100 grams liberating 60.27 kilograms of carbon dioxide as compared with 58.66 from tartaric acid. Its difficult solubility in cold water is a disadvantage. In lemonade manufacture, the use of water-soluble homologs is preferable, for example, B-methyl adipic acid, which may be derived from methylcyclohexanol or even from cresols. In the latter case it is associated with acetylvaleric acid, but this type of mixture can find application in the textile, leather, and other industries.

Of comparatively great importance, however, are the esters of adipic acid. Foremost among these are the neutral esters of cylic alcohols, which can be used as gelatinizing agents in all industries, such as the celluloid, artificial leather, lacquer, film, nitro-cellulose, or cellulose industries, which have hitherto resorted to camphor and expensive substitutes for camphor.

The methylcyclohexylester (Sitilan) dissolves not only cellulose esters but also rubber. It is used in the manufacture of leather-oils and varnishes, because of its softening effect which remains, even at low temperatures, a property of value in the manufacture of belts.

Sitilan can be used as an adhesive for celluloid and similar materials. The product obtained through the esterification of adipic acid and glycerine is at first a plastic mass but hardens subsequently to a point where it might be used as a substitute for resin, rubber, et cetera.



Planning high-speed business

An Advertisement of the
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Calls from one town to another used to be handled by one operator taking your order and giving it to another group of operators to put through. You now give your call direct to the operators who put it through — and put it through fast while you are on the line. The average time for handling all toll and long distance calls in the Bell System was further materially reduced in 1928.

A high-speed service to all parts of the country—calls from one town to another as swift, clear and easy as local calls—that is the aim of the Bell System.

This is one of the many improvements in methods and appliances which are constantly being introduced to give high-speed telephone service.

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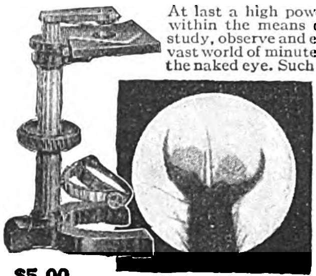

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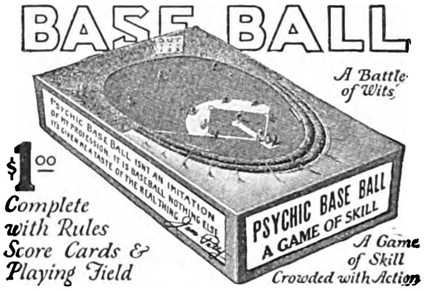
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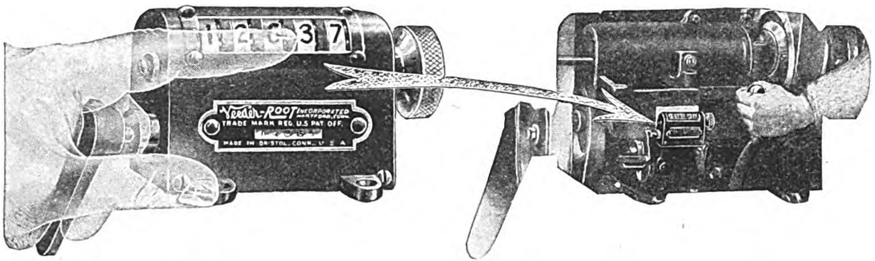

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Learning to Use Our Wings

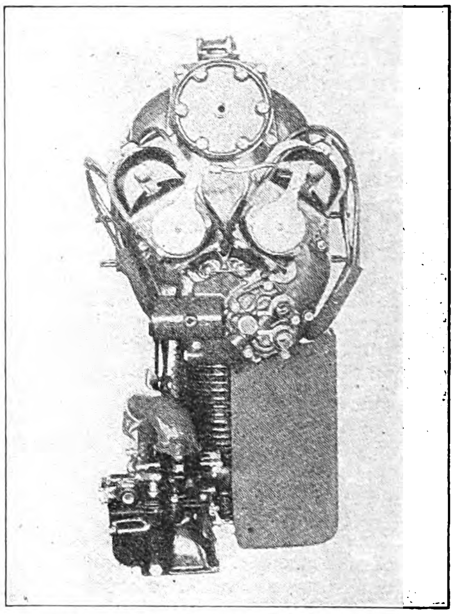
(*Continued from page* 456)

airport. It is only at the end of 200 hours of flying that he can obtain a transport license, and consider that he has put his foot on the first rungs of the ladder.

A Small Inverted Engine

WHAT are the tendencies in small air-cooled engines for light planes? They are likely to be of the cylinder-in-line type, because head resistance for this type is smaller than that of the radial type, the vision of the pilot is less obstructed, and an in-line engine resembles an ordinary automobile engine more closely than the radial engine, and so is easier for the average mechanic to handle. Another tendency is to have the engine inverted. An inverted engine impedes the pilot's vision even less than the ordinary in-line engine, and it is a trifle easier to work on an inverted engine than on the normal engine. Still another tendency is to seek ruggedness rather than extreme light weight.

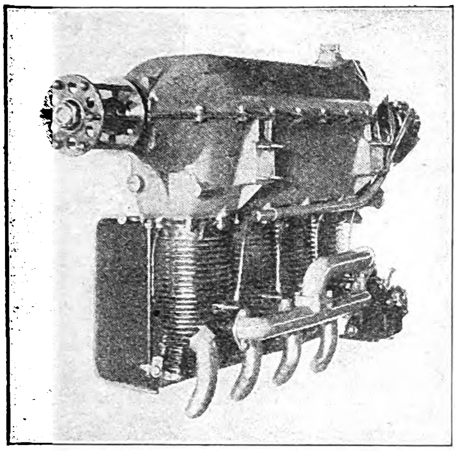
All these tendencies are exemplified in the Rover engine built by the Michigan Screw Company. The Rover has four inverted cylinders in line, and weighs 210 pounds for its 55 to 60 horsepower, which in airplane practice is fairly heavy. The cubic displacement is 236 cubic inches, which again shows no attempt at crowding power. As in all airplane engines, aluminum and duralumin are used freely. All the accessories are mounted at the back, so that the nose of the plane may be as clean as possible. Our two photographs indicate the neat and robust character of the Rover. Engines of this type should encourage the construction of light planes.


End view of Rover engine

Preparing An Airline

THE United States is rapidly being covered with a net work of airlines, and thousands of men are engaged in this new industry. J. G. Ray, in a paper before the American Society of Mechanical Engineers, outlines the hard and careful work which has to be done before a line is put into operation.

In the original selection of a line, the



Rover engine. See opposite page

determining factor is the volume of possible business, and a very careful survey has to be made. The next step is to get in touch with the cities along the route, and their Chambers of Commerce. Local people have to be stirred to enthusiasm in the matter of airports and landing fields, and at the same time to be so guided that they will not make mistakes in building such facilities. A desirable preliminary step is to fly over the route with a camera, making pictures every five or ten miles.

In the selection of equipment, the results of the business survey must be taken into account and there must be no undue optimism. If the work is carrying mail, and the estimated average load is 200 pounds, a 500-pound capacity plane is large enough to start with, and buying a plane with 1000-pound carrying capacity is extravagance.

Mr. Ray states that an airline will need a pilot for approximately every hundred miles where a single schedule is maintained. If the schedule can be so arranged that every pilot can have his own ship, so much the better. Every airplane "feels" different, and every set of instruments functions in slightly different fashion. Therefore a pilot will do much better with a plane to which he has become accustomed.

An airline should be divided into operating divisions which are between 300 and 500 miles long. Two divisions can be grouped under one superintendent who is stationed at the connecting terminal. Inspection and maintenance work should be concentrated at this station. At other division points, particularly if only small planes are employed, the personnel comprises only a field manager and a mechanical crew. At the intermediate stops very little fixed equipment is needed.

Servicing of the planes should not be necessary at these intermediate stops. It is at the ends of the division that a hangar is necessary, with a certain amount of office space, and space for mechanical shops.

At the operating base, larger shops are needed. A parachute loft should be provided, as well as an instrument room completely equipped to test all instruments. The overhaul shop should be very complete, and ought to include a stand for testing motors after overhaul. The navigating instruments, particularly the bank and turn indicator, the air speed indicator, and the compass, must be kept in perfect condition.

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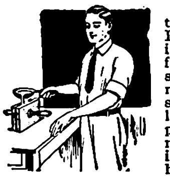

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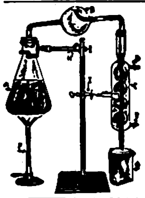

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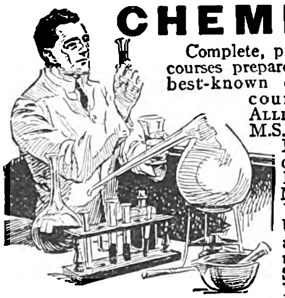

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Current Bulletin Briefs

(*Continued from page 462*)

of Production, by J. W. Paul of the United States Bureau of Mines, is a study of the influence of changes of temperature and moisture on the roofs of coal mines. This study, designated as Technical Paper No. 410, has 40 pages and 25 charts. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

The Classification of North American Coals, Information Circular 6094, is a report of the progress being made to correlate and combine the various coal classification systems into a standard system applicable to all North American coals. *U. S. Bureau of Mines, Department of Commerce, Washington, D. C.—Gratis.*

Engineering

Geology of Reservoir and Dam Sites, with a report on the Owyhee Irrigation Project in Oregon, presents valuable information regarding the geology, construction, and attendant problems of dam sites, dams, and spillways, of various major projects. *U. S. Government Printing Office, Washington, D. C.—30 cents.*

The Place of the Complete Corrosion Survey in Industry is a reprint from a recent article in the *Gas Age-Record* describing the Richards method of conducting sub-soil corrosion surveys, for long-distance pipeline projects and city distribution systems where metal buried underground is subject to corrosion. *Ford, Bacon, and Davis, Inc., Engineers, 39 Broadway, New York, N. Y.—Gratis.*

Industry

High Temperature Insulation presents information regarding materials used for boiler and furnace insulation, with considerable data relating to temperature gradients and heat loss per square foot per hour through insulated and uninsulated walls. *Celite Products Company, Los Angeles, California.—Gratis.*

Electric Heat in General Electric Factories describes typical installations for electric heat in several different manufacturing processes, particularly in the treatment and manufacture of glass products. *General Electric Company, Schenectady, New York.—Gratis.*

Competitors Who Have Co-operated to Improve Quality presents facts and figures showing the outcome of several interesting experiments in co-operation. The booklet is well illustrated. *Electric Steel Founders' Research Group, Chicago.—Gratis.*

Trade Standards Adopted by the Compressed Air Society and Standards of the Hydraulic Society present valuable and practical information, particularly from the standpoint of the manufacturers, in these two branches of industry. The former is a 47-page booklet describing standards for air compressors, piping, and

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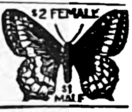

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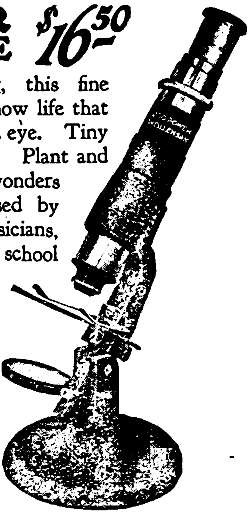

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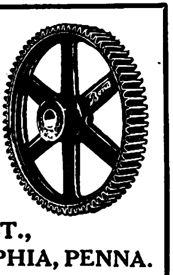

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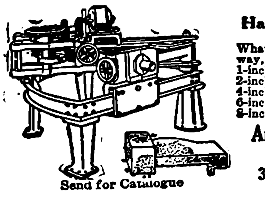

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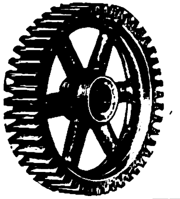

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pneumatic tools. The latter is a 78-page booklet dealing with hydraulic problems, pumps of various types and materials used in pumping certain liquids. Both booklets are distributed by *C. H. Rohrback, Secretary, 90 West Street, New York City.—50 cents each.*

Report of the Oxy-acetylene Committee is a well-prepared and comprehensive outline of the status of oxy-acetylene welding and cutting in modern industrial usage. *International Acetylene Association, 30 East 42nd Street, New York City.—Gratis.*

Oxwelding Pressure Vessels is a reprint from *Oxy-Acetylene Tips*, describing the most effective methods of welding high-pressure vessels of various kinds and designs. *The Linde Air Products Company, 30 East 42nd Street, New York, N. Y.—Gratis.*

The Increasing Usefulness of an Imaginative Industry is the year book and annual report of one of the country's largest gas companies. The artistic and inviting makeup of the booklet is almost as noteworthy as is the capable presentation of the story of Baltimore's industrial expansion and outlook. *Consolidated Gas Electric Light and Power Company, Baltimore, Maryland.—Gratis.*

Trade

United States Trade with Latin America in 1927, by H. S. Guista, describes the trade of the United States with South and Central America in far more detail than preceding bulletins. The writer shows the significant trends in transactions with our southern neighbors. *United States Government Printing Office, Washington, D. C.—15 cents.*

Foreign Trade of the United States in the Fiscal Year 1927–1928, by Lawrence B. Mann and Grace A. Witherow, discusses briefly the distribution of trade, the commodities handled, and the values involved. *United States Government Printing Office, Washington, D. C.—10 cents.*

Sociology

Propagating Crime Through the Jail and Other Institutions for Short-term Offenders is a report of a subcommittee of the National Crime Commission. The sub-committee, headed by Frank O. Lowden, reports that "it is essential to catch more criminals, but it certainly is not wise to confine nine tenths of them in institutions which merely make imperfect men still more imperfect." *National Crime Commission, 120 Broadway, New York, N. Y.—Gratis.*

Suicide Problems is a 270-page book by Dr. Fred. L. Hoffman, presenting comparative records of the suicide rate among various groups in this country. The book also contains discussion as to the methods and motives of self-destruction. *Prudential Insurance Company, Newark, N. J.—Gratis.*

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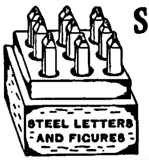

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Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Lumber Exporters Urged to Use Brand

ONE of the principal assets of an exporter of lumber or lumber products is an established brand, according to a recent statement of the United States Department of Commerce. The exporter is urged to take this step for his own protection, according to the Department, because unmarked lumber often sells at a lower price than marked lumber of the same quality.

"An established brand or shipping mark is one of the principal assets of a lumber exporter. Too much consideration cannot be given the importance of establishing a brand in the foreign lumber markets," the statement says. "The importer or agent realizes that the exporter with an established brand has a certain reputation to live up to, and that this reputation has been built up through constant effort, and has developed a standard for quality and manufacture that is recognized in the foreign markets."

It is further pointed out that American exporters should give careful consideration to the advisability of registering brands or shipping marks in the foreign countries in which they are developing business. The laws covering registration of trademarks (brands or shipping marks) vary in most foreign countries, and in many countries ownership of a brand can be established only by registration. In such countries, if the mark of an American shipper is registered by another, the American shipper is precluded from the use of the mark except through or with permission of the party holding the registration.

In this same connection, it is interesting to note that the branding or grade marking of soft-wood lumber is now being taken up on a nation-wide scale in the United States, as a means of establishing confidence on the part of the ultimate consumer.

The matter of registering trademarks in foreign countries, or for use in the United States, should be taken up with a reputable firm of patent and trademark attorneys equipped to care for foreign registrations. The best of these firms maintain departments for handling foreign business of this sort, and are always glad to furnish general or specific information upon request.

Inventors and Engineers Lauded

SO much has been said recently in praise of engineers that it is interesting to note some credit being given to inventors, who so frequently work hand-in-hand with engineers. Dr. Glenn Frank, president of the University of Wisconsin, presents an English translation of a certain German book in which due tribute is paid to inventors as well as engineers. The following quotation from the book is significant:

"The true champions of the masses are our engineers and inventors. The inventor of the automobile has benefited horses more, has saved them from more toil and suffering, than all the world's societies for the prevention of cruelty to animals. We have no galley slaves because they have been emancipated by the inventor of the marine engine. The use of fuel oil has redeemed an army of stokers from the inferno of the stokehole. The ultimate end of technical progress is to provide every man with the comforts and conveniences that are today reserved for millionaires. Therefore the inventors and the engineers are fighting want and poverty, they are not fighting wealth; they are fighting slavery, they are not fighting rulers; their object is to universalize wealth, power, leisure, beauty, happiness. The ideal of the engineers and the inventors is not to make all mankind a proletariat, but to make all mankind an aristocracy."

What Do You Mean—Rayon?

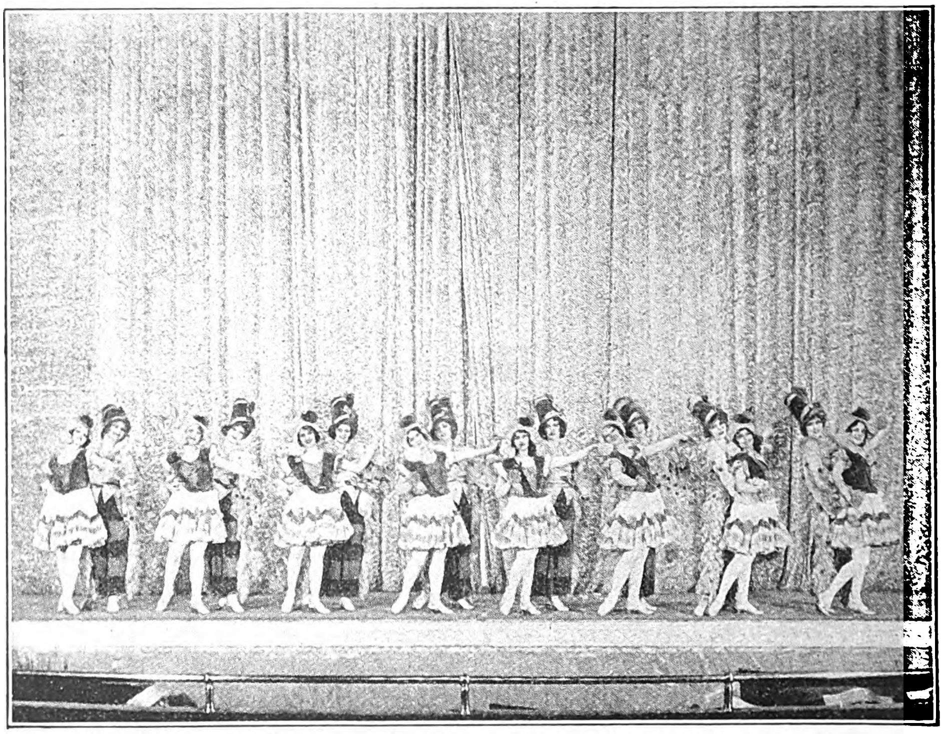
IT is not difficult to ascertain, by test, whether a fabric is cotton or flax, wool or silk. Each material has a certain composition and formula, and responds to certain tests in a characteristic way. But try to test several samples of "rayon." The analysis will show that rayon may be one thing in one shop, and something quite different in a shop across the street. In the rapid development of the artificial silk industry there have appeared eleven manufacturing firms producing fibers that are known as rayon, although not all have the same formula, and not all have the same constituents. Naturally the properties and characteristics of the various products are somewhat different.

But regardless of the difference, the Better Business Bureau, backed up by the Federal Trade Commission, has designated "rayon" as a general term, with the same significance as the words "cotton," "silk," or "wool." All artificial silk is officially known as rayon. This action was taken to safeguard those who might confuse real silk with man-made imitations.

As it has been pointed out by *The American Silk Journal*, in a recent issue, we have viscose and acetate, cupra-ammonium and nitro-cellulose "rayons," and they all respond differently to tests. The resulting confusion troubles wholesale and retail buyers even more than it does the public.

Among the manufacturers who protest against having their products classified as "rayon" is the Celanese Company. Many a silk-worm has gnashed its teeth when somebody mentioned Celanese, for that is the product that has displaced natural silk as the draperies and alleged garments that more or less cover the "glorified American girl" in most of the current Broadway stage attractions. It is the contention of the Celanese company that its product responds to tests in an entirely different manner than common rayon; it dissolves in acetone; it leaves, when burned, a crisp ash-like material, but without smell; it shows distinctive chemical qualities; and it dry cleans by the usual methods, although precautions must be taken against liquids that contain chloroform, ether, or acetone.

"There is no doubt that there is a growing interest in rayon," according to *The American Silk Journal*. "Silk always will be silk, and it will always have its intrinsic value because it has three times the tensile



Artificial silk is now being used for draperies, curtains, and costumes, in some of the elaborate musical comedies on Broadway. This scene, showing one of the luxurious Celanese curtains, is from Earl Carroll's production, "Fioretta" strength of rayon. But the lustrous beauty of some of its substitutes has given them a firm place in the industrial world, and particularly in the manufacture of things beautiful. This year we will use about 115,000,000 pounds of rayon, and 50,000,000 pounds of silk, according to the most accurate data obtainable from the rayon producers and the Silk Association of America."

In materials that have artificial silk in a mixed weave to bring out the details of a pattern, it doesn't matter very much what its chemical reaction may be. But when one sees a product designated as all "rayon" or "Celanese," or whatever it may be called, one is naturally interested in the composition of the material.

Regarding Trademark Renewals

UNLESS the request for renewal of a trademark is made "at any time not more than six months prior to the expiration of the period for which the certificates of registration were issued or renewed," the petition for renewal will be denied.

This was decided by Commissioner Robertson, in ruling that the Regal Shoe Company, of Boston, could not file an application for a renewal of the registration of a trademark, in view of the fact that the 20-year period had expired. Obviously the purpose of the renewal is to keep the registration in force, the Commissioner declared, otherwise the office would be granting a new certificate of registration.

Trade Commission Decisions

LIKE a vigilant watch dog, defending the property of those to whom it belongs against all who might seek to steal it or acquire it without due right, the Federal Trade Commission appraises the merits of all comers in any controversy over trademark rights and other commercial property. In most cases decided by the Federal Trade Commission, the consuming public is the primary beneficiary. Several recent examples of these decisions may be cited to show the policy of the Commission.

"English Broadcloth" and "Imported English Broadcloth" cannot be used as a label for shirts or other garments unless the goods bearing the label were made in England. Hyman Finkelstein, a New York dealer in shirts, bought a cotton fabric termed "broadcloth" by its American manufacturer. But by the time the cloth had been manufactured into shirts, it had become "English Broadcloth," according to Finkelstein's labels. It was ruled that this practice was calculated to deceive not only the retail dealers with whom he did business, but also a substantial portion of the purchasing public, into the belief that the shirts so labeled were made of material imported from England. The word "broadcloth" is not, in England, applied to any cotton fabric.

Seeking to capitalize on the popularity of union-made goods of certain types used largely by members of various trade unions, a manufacturer of overalls labelled his product "Union Made" although his employees were not members of any union. The manufacturer has signed an agreement with the Federal Trade Commission whereby he promises to refrain from this objectionable practice.

In cases of this kind, the names of individuals or firms signing stipulation agreements are not mentioned by the Commission in its announcements to the public. The facts are presented, however, to show methods of competition condemned by the Commission as unfair, for the guidance of industry and protection of the public.

A large corporation engaged in the manufacture of powders and concentrates for use in the preparation of beverages and soft drinks has promised to cease representing that its products are produced from apples, raspberries, grapes, oranges, and other fruits. This company also manufactures soaps, and has agreed to cease representing its products as "Pure Olive Oil Castile Soap" when in truth the soaps are not manufactured from olive oil. Certain "Lemon Complexion Soap" and "Lemon Soap" produced by the same company will hereafter be known by a different name, or be *bona fide* lemon products.

"The University of Applied Science," operated by T. J. Cook of Chicago, must cease representing to its prospective pupils that the price of a course of instruction offered is a special or reduced price, when such is not the fact. Mr. Cook was guilty of a number of practices on which the Federal Trade Commission frowned. He was ordered to desist from representing that any article of merchandise or service is furnished free to pupils, when the price of such is included in the regular price of the course; from representing that he furnished to the prospective pupil a life membership in an "identification bureau;" and from representing that his business is a "University of Applied Science." He was also told to discontinue the practice of alleging that he is the president of a "university."

Novel Combination of Old Practices

IN a patent infringement suit involving mechanical excavators and ditchers, it has been held that pull-stroke machines are different from the ordinary steam shovel in that they dig inwardly, as a hoe or a pick, rather than away from the machine, as a shovel. In the case of Keystone Driller Company *versus* the Byers Machine Company, et al, in the district court for the Northern District of Ohio, it was pointed out that the plaintiff's patent device accomplished old results in a new and useful manner, as well as new and better results, by reason of a novel combination of some old elements.

The judges found that the patents of the plaintiff were infringed by the defendant's constructions. The Keystone Driller Company had developed the art to a new point, and, in the opinion of the judges, the defendant had constructed its "Byers Bear Cat" machine as a result of studying the plaintiff's conceptions, and copying the mechanism and construction of machines patented by the Keystone Driller Company.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

AIRCRAFT—Having a special form of shock absorber which is particularly adapted to relieve the craft of undue shock when effecting a vertical landing, or when the craft is landing in an emergency. Patent 1701407. Rogelio Garcia, 134 W. 103d St., New York, N. Y.

Pertaining to Apparel

SEASHORE OUTFIT—For street wear, or on the beach as a dressing gown, and so arranged that a bathing suit may be put on or taken off while wearing the garment. Patent 1696714. Nathan Heller, 1575 East 8th St., Brooklyn, N. Y.

COMBINED SUPPORTER AND UNDERGARMENT—For women, equipped with means for drawing inwardly and downwardly on the diaphragm, to give the figure a graceful appearance without injury to the vital organs. Patent 1701425. Rose B. Scognamillo, c/o Mrs. Rose Binner, 561 5th Ave., New York, N. Y.

SEPARABLE FASTENER—A flexible linking means of the separable button-type for the normal fastening of cuffs, or a loose spaced fastening such as is desirable in warm weather. Patent 1701461. Palmer L. Graham, 806 Ohio St., Terre Haute, Ind.

COMBINATION GARMENT AND CARRIER BAG—Particularly adapted for a raincoat, in which the bag may conveniently serve for a hood when the garment is worn, and a container when the garment is transported. Patent 1702143. David Weisz, 750 Caldwell Ave., Bronx, N. Y.

HAT—Of the so-called sport type for ladies, formed of a plurality of plaited strands, having strength and durability to hold its shape, yet may be folded for packing. Patent 1701130. Gerald H. Simon, 989 Market St., San Francisco, Calif.

Designs

DESIGN FOR A SHOE—Patent 77345. Herman Wilhelm, c/o Bernard Barnbaum, 1440 Broadway, New York, N. Y.

DESIGN FOR AN EMBLEM OR THE LIKE—Patent 77648. Carl K. MacFadden, 17 Battery Place, New York, N. Y.

DESIGN FOR A STOCKING—Patent 77715. Clarence B. Smith, c/o Leo Frankel, 244 Peachtree Arcade, Atlanta, Ga.

Electrical Devices

CIRCUIT CLOSER—Adapted to sound an alarm when a jewel or money box with which the circuit is associated, is lifted bodily from its support, or when its lid is raised. Patent 1696713. John T. Harrigan, 425 Walnut St., Elizabeth, N. J.

RESISTANCE—Which is very sensitive and accurate and may be readily adjusted to vary the action, may be used with current rectifying devices, telephone stabilizing or other electrical uses. Patent 1701386 George J. Mucher, 4 Park Place, Troy, N. Y.

SELECTOR AND AUTOMATIC TONER FOR RADIOCIRCUITS—Which makes use of a novel selector for tuning a receiving circuit with the incoming wave; the tuning element being controlled by the surge of plate current at resonance, the tuning may be operated by a distant control. The inventors have been granted two patents, 1700281 and 1700282. Elmer E. Burns, and Theodore Cohen, 3515 Home Ave., Berwyn, Ill.

Separable Electrical Connection—Which embodies a lamp bulb and associated socket, so constructed that the bulb may be inserted into the socket by direct thrust as opposed to a turning movement. Patent 1702135. Thomas C. Sawers and Harry J. Blair, 1502 Ave "H," Brooklyn, N. Y.

Electromagnet - Controlling Means—For circuits including electromagnets, especially where the electromagnets are employed for releasing spring latches, which is comparatively simple in construction and operation and economical to install. Patent 1703077. Harry D. Wethling, 318 Main St., Orange, N. J.

Of Interest to Farmers

Shock Loader and Conveyer—A machine for piercing a succession of shocks, subsequently elevating the same to a position whereby they are out of contact with the ground, and then transporting the loaded shocks. Patent 1702141. Luther T. Velen, Cheswold, Del.

Igniting Device for Smudge Pots—Which is extremely sensitive, and rendered active by a thermo-responsive means, thus positively insuring ignition at a predetermined low temperature which would be injurious to a citrus fruit grove. Patent 1701133. Joseph A. Ulmer, 2501 E. 52d St., Huntington Park, Los Angeles, Calif.

Ridging Machine—Particularly adapted for blocking off land for irrigating purposes, is capable of adjustment for different kinds of soil, such as black adobe, or sandy loam, and requires relatively small horsepower. Patent 1700117. William S. Booth, Rout 1, Box 280, Mountain View, Calif.

Milking Machine—To be applied to milch animals for holding a teat and for squeezing the milk therefrom without causing a back-flow or other injury to the animal's health. Patent 1702468. Edward A. Englund, Route 5, Box 87, Hillsboro, Oregon.

Of General Interest

Combined Holder and Case—A portable means for carrying the cards, sheets, or a ledger in bookkeeping systems, from one place to another, the contents being readily removable, or closed under lock and key. Patent 1702996. LaRue R. Coppage, c/o Coppage Printing and Loose Leaf Co., 47 Warren St., New York, N. Y.

Lincrusta and Method of Making the Same—Whereby a two-tone effect is produced by a colored backing sheet with a plastic composition thereon, which is subjected to a die roller for embossing the design thereon. Patent 1702161. Milton K. Huppuch, c/o The Decorative Co., Hudson Falls, N. Y.

Card Holder—Which enables the easy and quick interchange of cards and provides a secure mounting for them when in use, particularly adapted for use in connection with advertising apparatus. Patent 1700786. Emmanuel Dobrowsky, 168 W. 96th St., New York, N. Y.

Combined Ironing Board, Convertible Table and Cabinet—In which the door, table and ironing board are supported in such manner that they are free to be swung outwardly from the cabinet, and adjusted to working position. Patent 1700545. Clyde W. Sanders, 1915 Yosemite Drive, Eagle Rock, Calif.

Sealing of Bottles—Wherein both inside and outside of the neck are threaded, a soft stopper being screwed into the neck, while a cone of hard material, in the screw cap, forces the soft stopper into an air-tight fit. Patent 1702182. Joannes M. B. Van Vlijmen, c/o Nederlandsch Octrooi-Bureau, 31 Laan Capes Van Cattenburch, S. Geavenhage, Holland.

Safety Razor—Wherein a double edge blade may be used, but only one edge in operation at a time, the guard being swingable to permit the honing of the blade. Patent 1701462. Charles M. Hickey, 30 W. 59th St., New York, N. Y.

Weather Strip—Especially adapted for application to a door frame, a flexible element which will be engaged by the opposed edge surface of the door, and will retain its flexing condition. Patent 1702217. Augustus Miller, 70 Greenwood Ave., East Orange, N. J.

Awning—Having adjustable parts to cause the awning to function as a sun shield or a combined sun and rain shield, yet permitting a free circulation of air. Patent 1700555. Karl N. Watkins and Stiles O. Clements, 1128 West 7th St., Kis Angeles, Cal.

Doll Construction—Wherein the appendages may have rotatory movement and the legs, arms and head may be connected in a novel manner, without the use of springs or wires. Patent 1702208. John Glow and Hyman E. Chiet, c/o Allied Grand Doll, 66-68 Greenpoint Ave., Brooklyn, N. Y.

Package Container—Formed of light metal, for the reception of a package of cigarettes, and constructed in such manner that partial ejection can be effected, and individual removal facilitated. Patent 1700539. Allston C. Ladd, c/o Union Printers Home, Colorado Springs, Colo.

Cigarette-Package Holder—Which includes a skeleton framework with a hinged cover, serving to prevent crushing of the package and its contents, while permitting the ready withdrawal of the cigarettes. Patent 1702187. John Wolfe, 20 Rue de la Paix, Paris, France.

Nail Clipper—Which is compact and durable with no protruding corners or sharp edges, the operating lever acting as a locking member when the parts are in closed position. Patent 1702137. Max Schnefel, 684 So. 17th St., Newark, N. J.

Portable Crib—Which when extended will support an infant in reclining position, includes a flexible body which may be readily detached for laundering, and may be easily collapsed for transportation. Patent 1702015. Louise A. Mand, 122 North Mariposa St., Los Angeles, Calif.

Toothbrush Holder—Adapted to house the bristles of a brush, and keep them in an atmosphere impregnated with an antiseptic, for preventing germs or bacteria from propagating. Patent 1696706. Walter C. Athon, "Personal" Cody, Wyo.

Mask—Which may be decorated or undecorated, and when cut from a single blank, may be folded to produce a more or less projecting nose, forehead, eyebrows, and a supporting handle. Patent 1703034. Thayer Grimes, c/o Chas. Frank, Room 2160 Graybar Bldg., 420 Lexington Ave., New York, N. Y.

Portable Lighter—Which is designed to be carried in the pocket of the user and operated by one hand to light a cigar or cigarette, a spring-pressed latch controls the ignition. Patent 1703033. David W. Greene, c/o M. E. Bernhardt Co., 230 Fifth Ave., New York, N. Y.

Magazine Pencil—Adapted to contain a supply of leads of standard diameter, which are successively fed to a projected writing position without breakage, jamming, or clogging. Patent 1703038. William K. Holmes, 409 Pearl St., New York, N. Y.

Window-Frame Construction—Including a sill and side casing cut to provide rabbeted joints which excluded the elements of weather, such as air and water, and prevents the consequent rotting of the frame. Patent 1703021. Charles G. Voigt, 121 W. Marie St., Hicksville, L. I., N. Y.

Insect Trap—In which the mature female mosquito may readily lay her eggs, but which will prevent the escape of the larvae after the eggs have hatched, thus preventing their propagation. Patent 1703022. William Weinrich, Box 2713, Honolulu, Territory of Hawaii.

Tray—Designed to constitute a container unit to be emplaced on shelves in stores for holding articles of merchandise, the articles being always dressed to the front of the shelf. Patent 1702987. Gordon C. Wilson, Glendo, Wyoming.

Index Book—Having a plurality of cards disposed to take up a minimum of space, each card being hinged so that in either turned-up or closed position the tabs are readable. Patent 1702357. Carl A. Meilicke, 5423 Winthrop Ave., Chicago, Ill.

Connecting Means for Straps—Capable of being instantly connected to and secured against disconnection from, a wrist watch or other article, without rendering the straps bulky or uncomfortable to the wearer. Patent 1702855. Arthur W. Swanson, c/o Cordova Leather Shop, 643 So. Olive St., Los Angeles, Calif.

Hardware and Tools

Combination Tool—Which is a combination of an adjustable miter square, a perpendicular and a horizontal level bubble, a rule and a sliding marker, adjustable on a scale. Patent 1695662. Edgar G. Morin, Jr., 4004 20th St., San Francisco, Calif.

Spirit Level—So constructed that a broken bubble tube can be readily replaced, and the mode of adjustment being such that ordinary jars will not render the level inaccurate. Patent 1703006. Ralph H. Jay, 1230 Ferry St., Eugene, Oregon.

Alcohol Injector—Whereby alcohol or analogous fluid may be forced or directed into a gas pipe to clear the same when the gas in the pipe is frozen. Patent 1702972. Louis J. C. Larsen, 506 W. 49th St., New York, N. Y.

Scoop—Which will not only serve for scooping ice cream or other edible products, but will be positive in its action to eject the formed quantities for confections or other purposes. Patent 1703023. George C. White, 382 Chapman St., Irvington, N. J.

Door Lock—In which the lock housing and the latch are extensible for use on different standards of doors, and whereby an outer knob may be locked from the inside against operation. Patent 1701790. Edgar G. Morin, Jr., 4004 20th St., San Francisco, Calif.

Wrench—Having a fixed jaw, and a detachable section, which may be readily replaced when worn, is adjustable, and particularly adapted for gripping pipes or circular objects of various diameters. Patent 1702148. Roy J. Breseman, 125 Harrison St., Waupaca, Wis.

Heating and Lighting

Heating Device—In the form of a gas heater, and a spark plug for igniting the gas, means being arranged to automatically open the switch after ignition has been attained. Patent 1700559. Louis F. Clausing, c/o Royal Metal Works, 3588 20th St., San Francisco, Calif.

Machines and Mechanical Devices

Mechanism for Use With Articulated Mold Forms—For concrete, the sectional frame having a plurality of alined tie elements held by a locking tie rod, and means to grip and releasably hold said rod. Patent 1696699. Harold R. Suiter, c/o Concrete Form Co., 326 Mt. Vermon Ave., N. W. Grand Rapids, Mich.

Coin-Controlled Vending Machine—Wherein the parts are so constructed as to prevent the use of spurious coins, and which automatically locks itself when the last article has been vended. Patent 1702154. Dwight T. Clark, 11 Lincoln St., East Orange, N. J.

Fluid-Pressure Pump—Having a pair of balanced valves forming inlet and discharge valves, for a fluid under pressure and adapted to force liquid from the well through a separate-discharge pipe. Patent 1701449. Forrest E. Gilmore, 728 Wright Bldg., Tulsa, Okla.

Film Signaling Device for Cameras—For preventing double exposure or non-exposure of a film, the device may be applied to conventional cameras, with but slight structure modification. Patent 1696533. Fred W. Gage and Albert W, Tondreau, 1519 Cambria St., Los Angeles, Calif.

Hat-Renovating Machine—Having simple and effecting means for steaming the brim of the hat, for altering the shape of the brim, and for pressing both sides of the brim. Patent 1695646. Louis Flicker, 1415½ Fifth Ave., Los Angeles, Calif.

Apparatus for Handling Well Casings—Through the medium of the conventional rotary drill pipe, the invention being characterized by the substitution for the hydraulic means of a mechanical means for engaging the casing. Patent 1696526. Carl R. Crossen, Route 1, Box 254, Los Gatos, Calif.

Dishwashing Machine—Comprising a washing compartment, a motor driven propeller, for circulating water in said compartment, the weight of a dishpan being enough to start the motor in operation. Patent 1699042. James L. Bell and Hermann Euwecke, 2211 Market St., Oakland, Calif.

Device for Drying, Steaming, and Conditioning Tubular Fabric—A device including a duplex coil, over which tubular fabrics may be drawn for removing excess moisture, and then "conditioned," or steamed to give the desired finish. Patent 1696682. Maurice M. Kasanof, 3190 Rochambeau Ave., Bronx, N. Y.

Brickmaking Machine—A mold for forming hollow concrete blocks having one surface faced to simulate bricks presenting an odd number on one row and an even number on another row. Patent 1701438. Fred T. Baum and Clarence G. Norris, c/o B. & N. Brick Tile Mfg. Co., Marion, Ind.

Multiple Face and Pointer Construction for Gauging Instruments and Weighing Machines—Which is not unduly complicated and may be read from practically any direction in which it is viewed, thus materially increasing its efficiency. Patent 1701412. Henry J. Lawrenz, 1823 Church Ave., Brooklyn, N. Y.

Boat-Propelling Means—Comprising an upstanding frame, and means for manually driving the propeller at a relatively high speed, the frame being foldable to inactive position below the gunwales of the boat. Patent 1701381. Mattia Marangoni, 308 East 25th St., New York, N. Y.

Apparatus for Making Pretzel-Stick Dough Blanks—In which the dough is conducted over a tortuous path and changed from the lump form from the mixer, to a succession of rods and in condition for baking. Patent 1701850. George W. Holtzman, c/o Pretz-Stick Baking Co., Myerstown, Pa.

Fabric or Cloth Unwinding or Unrolling Machine—For supporting a bolt or roll of fabric to permit any desired length being taken therefrom or placed thereon, without the fabric being folded by hand. Patent 1702971. Wootton W. Jefferess, Box 1204, Dallas, Texas.

Soap-Paste Dispenser—Which includes a manually operable discharge mechanism which will exert a pressure for dispensing varying quantities of the soap, constituting an economical, convenient, and sanitary medium. Patent 1703032. Horace P. Gorman, 86 Grandview Ave., Rye, N. Y.

Machine Bar—An element terminating in a ball and socket member, whereby it may accommodate itself to any required position, for employment as a mining column for supporting rock drills. Patent 1701122. LeRoy E. Ridgeway, 3115 E. 4th St., Long Beach, Calif.

Cable Connection—Whereby drilling apparatus of the rotary type may be withdrawn from a well in the event of a breakage, either in the drill pipe, or the drill. Patent 1701812. George H. Koerner, 314 Moraga St., San Francisco, Calif.

Coin-Controlled Radio Reception Apparatus—A time measuring mechanism for radio broadcasting, whereby after the deposit of a predetermined coin, the radio-reception circuits are automatically closed a predetermined length of time. Patent 1702411. William N. Olsem, 1678 Sacramento St., San Francisco, Calif.

Medical Devices

Rubber Nozzle for Chemical and Like Purposes—Adapted to fit over the neck of a bottle or the like, and allow the liquid to continuously and uniformly flow therefrom when the bottle is inverted, without creating bubbles. Patent 1701421. Ernesto G. Ponti, c/o G. Capuccio, Via Arsenale N. 17 Turin, Italy.

Prime Movers and Their Accessories

Current-Conducting Apparatus—For internal combustion engines, wherein the distributor and conductors to the spark plugs are insulated by a solid conduit, to prevent short circuits, thereby producing a maximum current. Patent 1692087. Francis H. Matthew, Martin A. Broadbere and Frederick C B. Vosgerav, Box 15, Walnut, Calif.

Engine—Having a peculiar mode of connection between the pistons and the power shafts, whereby owing to the elimination of many parts, power and smoothness of operation are increased. Patent 1701439. Charles G. Canfield, Yale, Okla.

Railways and Their Accessories

Grade Crossing—A device which provides positive means for slowing up vehicle traffic adjacent to railroad tracks, may be applied to any crossing without altering the road construction. Patent 1699886. Roy H. Gerard, 817 Phelan Bldg., San Francisco, Cal.

Automatic Crossing Block for Railways—An electric system which causes gates to be closed and a signal bell rung as the train enters a block, and releases the gates when the train leaves the block. Patent 1702150. Taylor M. Cain, Box 383, Ogden, Utah.

Pertaining to Recreation

Sporting Gun, Rifle and the Like—A double barrel gun of the under-and-over type, provided with locking bolts and an inertia weight slidably mounted to automatically effect the cocking of the second trigger on the firing of the gun. Patent 1702153. Arnold L. Chevallier and Robert Churchill, c/o E. J. Churchill, Gunmakers, 39 Leicester Sq., London, E.C., England.

Amusement Apparatus—In which power driven passenger carrying conveyances are caused to move eccentrically, and are given sudden jerks in various directions, in order to provide unexpected thrills and excitement. Patent 1702136. Thomas Sawers and William E. Evans, Jr., 1502 Ave "H," Brooklyn, N. Y.

Pertaining to Vehicles

Tire Shoe—Especially designed to be quickly attached to an automobile tire and adjusted to positively grip the tire, regardless of its size, without marring the felly. Patent 1695450. F. H. Bryant, Box 591, Mill Valley, Cal.

Brake - Releasing Device — For automatically releasing the hand or emergency brake of an automobile, the releasing operation being accomplished by the depression of the clutch pedal. Patent 1696702. William H. Watlington, Colorado Life Co., Patterson Bldg., Denver, Colo.

Automatic Exhaust Valve—Adapted for a practically instantaneous exhaust of an air actuated machine operated through remote control irrespective of the speed of operation of the contral valve. Patent 1697353. Ervie A. Ferris, Box 3, Westwood, Calif.

License-Plate Holder—Adapted to be removably secured to some fixed part of an automobile, for positively retaining a license plate in spring pressed arms, against displacement or loss, yet readily removable. Patent 1701419. Joseph B. Peden, Temperance, Mich.

Demountable Rim and Tire Lock—So constructed as to render it applicable to all types of wheels and demountable rims, and will prevent an unauthorized person from removing the rim and tire from a wheel. Patent 1702139. Rogers W. H. Thomas, Newark Road, Zanesville, Ohio.

Automobile Spring—A semi-elliptical spring adapted to be interposed between the body and the axle, so constructed that as one end is compressed, the other will be expanded, and the body kept steady. Patent 1702030. Charles E. C. Edey, 2592 West Pico St., Los Angeles, Calif.

Oil and Air Filter and Lubricator—Particularly adapted for automobiles, wherein the lubricating oil is filtered, the air cleaned and caused to convey some of the oil to the interior of cylinders and inlet valves. Patent 1702156. William C. DeWitt, P.O. Box 150, Newburgh, N. Y.

Resilient Support for Cushion Seats—Which includes a frame and a plurality of independently mounted cushion supports which closely conform to the localized weight and are not canted by two persons of extremely different weights. Patent 1701831. Albert Weickman and Chancys Olmsted, c/o C. S. Olmsted, 218 E. 59th St., New York, N. Y.

Trouble-Light Outfit—Constructed and arranged to be "built into" an automobile, housed out of the way, yet always available for use, the cable being supported on a spring tension reel. Patent 1698643. William J. Mattson, Box 731, North Hibbing, Minnesota.

Fender Vise—For holding automobile fenders, to facilitate repairing, the arms are adjustable independently, and the mount universally adjustable, whereby the fender may be supported in any position. Patent 1697117. John R. Hilsted and Harry H. Canterbory, c/o Geo. G. Griffith, 124 East Lemon Ave., Monrovia, Calif.

Gear Shift—A clutch pedal having resilient means for causing the gears to be shifted without chance of stripping, the device may be readily applied to standard transmission mechanism. Patent 1698199. Arthur C. Nickell, Jr., 364 Broadway, Waukesha, Wis.

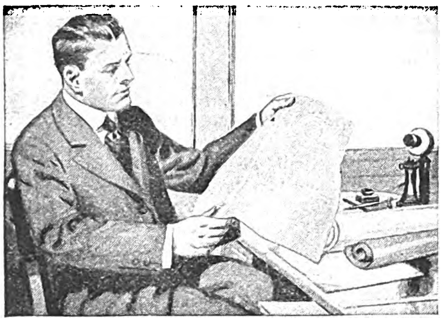
Guide for Automobile Jacks—By means of which a jack may be guided to jacking position beneath the axle without the operator having to go under the automobile. Patent 1699406. John E. Ravlin, Route 5, Miami, Fla.

Signal Device for Pneumatic Tires—For indicating to the driver of a vehicle, that low pressure exists, in sufficient time for him to reinflate the tire and prevent serious injury thereto. Patent 1699366. Joseph H. Loeb, Morgan City, La.

Shielding Device for Vehicles—For Shielding the occupants of a closed car against the elements from a window opening, or against the direct sun rays, yet will not obstruct the view. Patent 1698871. Stephen M. Beatty, 3810 W. 58 Place, Los Angeles, Calif.

Wagon Construction—In which the reach head of each reach bar is so designed as to not only afford maximum strength, but also the utmost freedom of movement. Patent 1698642. Francis A. MacNab, c/o Knight Ranch, Granby, Colo.

Lubricating System for Automobiles—A centralized system which includes an automatically filled reservoir having a plunger therein which when manually operated will supply lubricant to the various parts of the chassis. Patent 1703039. Henry L. Hubbard, 13823 Fernwood St., E. Cleveland, Ohio.



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SCIENTIFIC AMERICAN

June 1929

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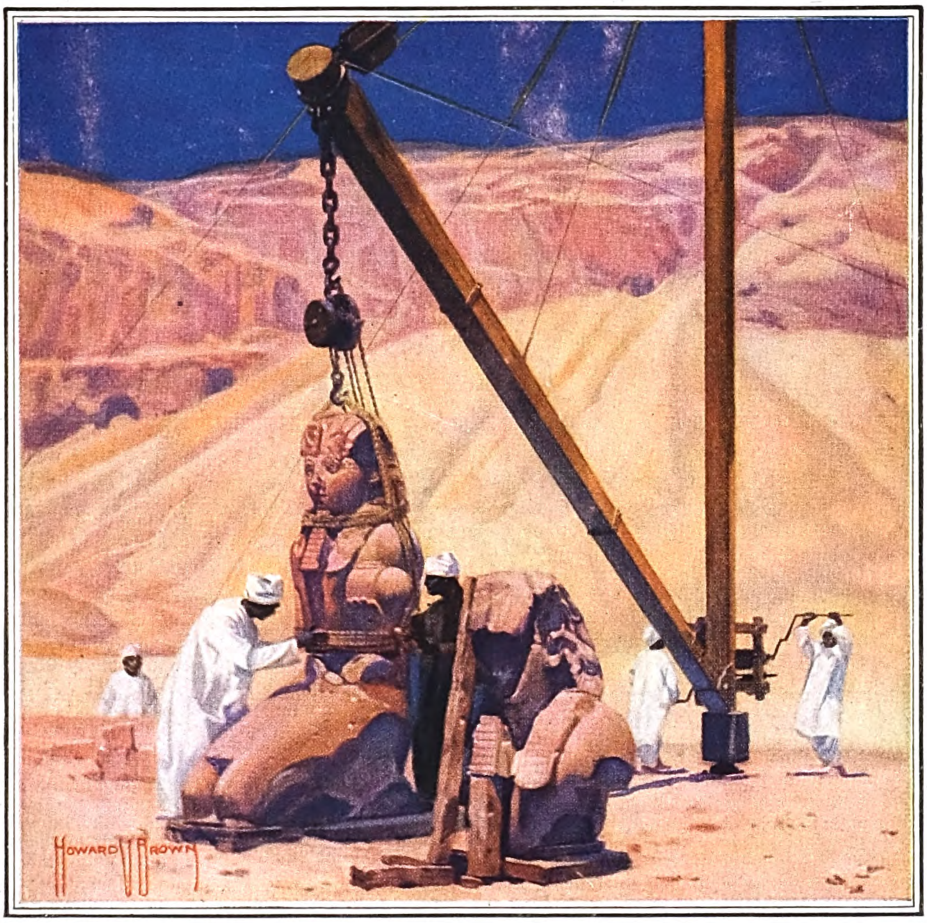

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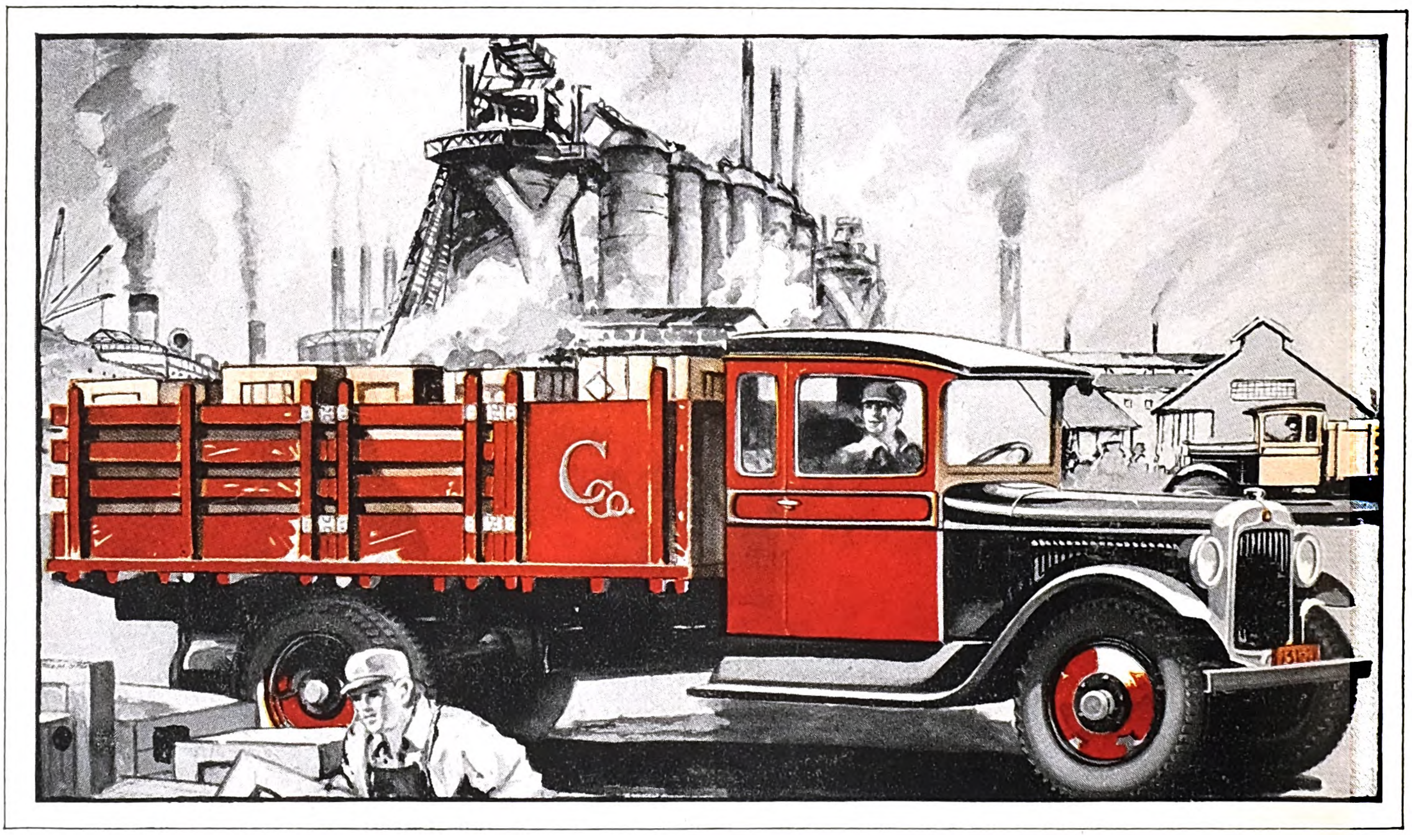

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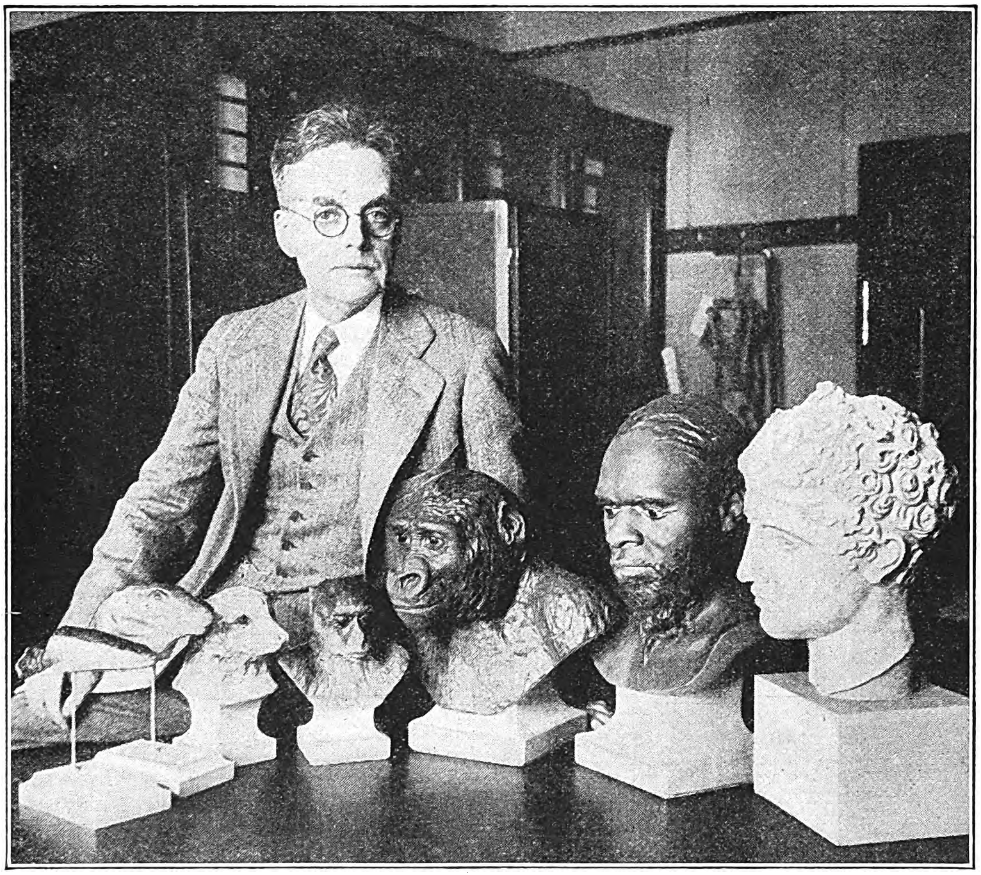

William King Gregory

TO some the words paleontologist, morphologist, and ichthyologist, which apply to the distinguished American scientist whose picture appears above, may call up thoughts only of dry, lifeless fossils and decades of close application to the dull stodgy archives of science pursued in some dusty attic workroom amid a profusion of biological specimens preserved in alcohol. If this be the reader's first thought let him cast it aside. We know of no more human, modern scientist than Professor William K. Gregory of Columbia University and the American Museum of Natural History. Paleomorphologists who answer to the above description there may have been in some past generation; but such scientists, somewhat fossilized themselves if the truth be known, are nowadays as rare as some of the fossils they studied. Modern morphology is the science of evolutionary changes in the forms of animals. Paleontology sometimes reveals the fossil records of these changes. The paleontologist and morphologist must of course be a comparative anatomist. He makes critical comparisons between homologous features of various types of animals, fossil and living, and familiarity with these and other anatomical features enables him to see about them altogether more than the outsider could be expected to see. This is true in any vocation, no doubt including the reader's. Surprisingly definite laws control the evolutionary changes in form of all animals. A thorough knowledge of these natural laws enables the morphologist to deduce much concerning the probable forms of extinct animals which are still missing from the fossil record, and many cases are on record in which the later discovery of the missing fossils have vindicated such deductions. The paleomorphologist, then, is primarily a student of evolution. What more fascinating field of science could there be? Dr. William K. Gregory is America's foremost paleomorphologist. His specialty—if so very inclusive a scope can be called a specialty—is all of the vertebrate or backboned forms of life. This begins essentially with the first fishes (hence "ichthyology") hundreds of millions of years ago, and follows through their successive descendants—the amphibians, reptiles, and mammals, including man. Dr. Gregory's latest scientific work, "Our Face from Fish to Man," traces this long line of evolution by means of the various parts of the head. In the photograph he is shown with casts exhibiting the main stages of this evolution. "The Origin and Evolution of the Human Dentition" is another of his books. It treats of the relationship of apes and man, especially as shown by the teeth. Dr. Gregory's attainments were recently recognized by the National Academy of Sciences, which elected him to membership in that noted body in 1927.

EXPLORING A STREET CROSSING FOR A FAVORABLE OPENING

Record A of Figure 3 gives a concrete idea of the actual movements of the eye at such a time. The subject is awake and alert. If extremely sleepy, the eye will perform badly, as shown in other records

Sleeping with the Eyes Open

Scientific Research Demonstrates That a Motorist or Anyone May Actually Be Asleep, Even if the Eyes Are Seen to Be Open

By PROFESSOR WALTER MILES, Ph. D.
Psychology Laboratories, Stanford University

IT is commonly supposed that sleep begins with the closing of the eyelids. Actors represent it so and children do the same. Of course when we *decide to sleep* we voluntarily close our eyes to favor the starting of this mysterious state. By dropping the lids we clear the "perceptive screens" of all forms and actions and thus we quiet down the visual centers. Then sleep may come—but not always. It is not wholly a matter of eyes or of visual centers, prominent as these are in the waking mental life of most individuals.

On the other hand, when *sleep overtakes us*, when we fall asleep contrary to our expressed desires to continue active, what is the real order of psychological events? Do we fall asleep with the fall of the curtains (lids) or before or after? Is it possible that drivers of vehicles and others carrying on tasks of much responsibility that are supposed to require practically constant vision sometimes really sleep while their eyes are still open? Such individuals, spurred by thoughts of the importance of staying awake and keeping the wheels turning, may possibly be able to control their muscles better or for a longer time than they can keep their retinas sensitive and active.

Profound sleepiness of the "overtaking variety" is not so easy to provide in the psychological laboratory. The case here reported and made the basis of this discussion came as a by-product in another experiment. The young man was a skilled typist earning a good salary. At the time of the experiments he was planning to get married and was very anxious to earn extra money. Therefore he had gladly arranged to serve as a subject in some night experiments on typing. He had agreed to a program of hours of sleep, and other routine for the consecutive eight days of the experiments. It was discovered later that he was not faithful to this program of sleep during the preliminary period. He did not retire until about 2 o'clock on two consecutive nights, and then came to the laboratory the next evening. He expected to bluff it through so that he might get his money, and I must say he did pretty well. But the eye-movement camera caught him and caused his confession.

THE technique which we used for recording the eye movements I have already described in the SCIENTIFIC AMERICAN.⑴ The eye not only serves as a small mirror, but the reflected image, be it window light or arc light, moves about in the eye with the movements of the eye. This movement of the image is due to the fact that the cornea (dark part) has a different curvature than the eyeball. If you change the position of this cornea, that is, turn it to the right or left, or up or down as is done when looking at different parts of a picture, you change the angle of reflection, and so the apparent position of the image. See Figure 1.

An illustration will make the principle of recording clear. Figure 2 is a picture, enlarged two diameters, of a human eye taken on a still plate. The resulting photograph appears grotesque because the eye moved during the exposure. First the eye was looking approximately in the direction of the reader's right shoulder, and the image of an arc light (the white spot) was also at the right in the photograph. Then when the exposure was half over the subject turned his eye as if to look at the reader's left shoulder. Now the image of the arc passed from right to left and it will be noted that the eye must have stopped at three distinct points. This is demonstrated by the three white spots at the left in the picture. A perfectly spherical eyeball would show no shifting of the arc-light image with such movements.

If in place of a stationary plate, as used for Figure 2, we use a steadily moving plate or film and a magnification of about nine times, and ask the subject to look alternately right and left to certain points, we secure records like those illustrated in Figure 3.

We must now give some consideration to the interpretation of such records before taking up the behavior of the eye during profound sleepiness. In A of Figure 3 we have a record which probably represents the typical

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1. "When Reading, Your Eyes Move in Jumps", SCIENTIFIC AMERICAN, November, 1926, pp. 354-356.

movements and pauses of the eyes of an individual who is looking back and forth before crossing a city street. The points to be looked at are many, and they are of unequal value as sources of interest. New ones may momentarily appear or old ones change on either side, hence the observer tends to alternate fixation from one side to the other.

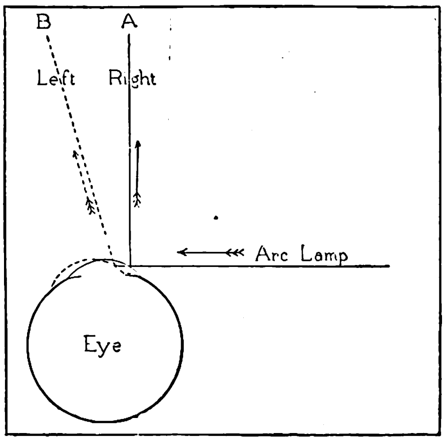

FIGURE 1

Figuratively speaking, from the many items on the ledger before him he momentarily strikes a stimulus balance and invests his behavior just then accordingly. In the record, the nearly horizontal dotted lines represent movements of the eye, shifts from one thing or position to another, each dot having a time value of 1/100 of a second. The vertical lines represent fixations, that is, steady pauses of the eye during which some object is consciously seen or in some way evaluated for the individual's behavior.

At the bottom of record A the shift of vision from right to left occupied .15 of a second. On the return movement, looking back to the right, the motion was started very rapidly but the individual batted his eye and so shut off the reflected light. In the other movements the time required varies from .03 to .10 second, approximately, according to the distance moved. An individual can not voluntarily control this rate of movement of the eyes. He of course controls the movement in the sense that he can keep his eyes fixed on an object or can shift them to a new position. Having made the choice to shift he has no control to make the movement itself quickly or slowly.

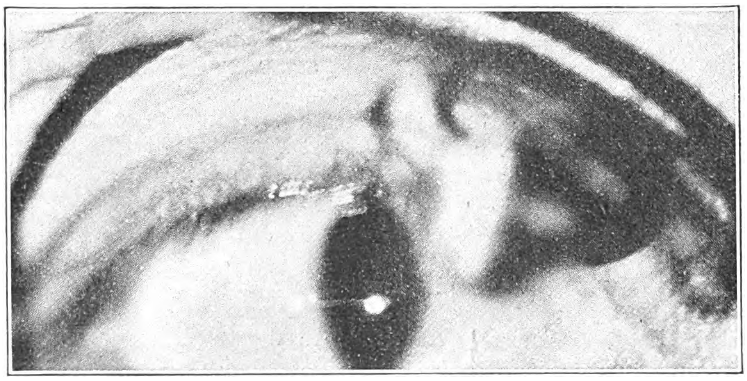

FIGURE 2

This type of eye movement is also employed in reading the printed page or in viewing a picture, and has been named the "saccadic movement." When we read fairly difficult prose material, the eye pauses for about .30 second; then makes a movement of one or two degrees of visual arc, executing this movement in approximately .01 second; pauses again for a fixation of about .30 second; makes another movement, and so on to the end of the line; whereupon there is a long movement from the right to the left-hand end of the next line of print. This last movement of adjusting to the next line will require perhaps .05 second.

Moving the eyes a distance of 40 degrees between two given points requires about .10 second. This value is so regular for adults in normal condition, and is so even for a given person for different days, that we may make it a measure to indicate physical and mental condition. As a measure it has the advantage of being somewhat like a reflex, while retaining certain features of voluntary action.

RECORD B in Figure 3 is normal and typical for this eye-movement test. The individual has looked back and forth alternately between two points that are 40 degrees apart. The looking and recording has been done with the right eye while the left eye was covered with a shield. We notice four characteristic features: (1) The lines of dots indicating movement proceed fairly directly from right to left and left to right, that is, they have very little curve in them. (2) The movements are faster in going from left to right. (3) When the individual is looking at one of the prescribed fixation points, the eye inscribes a vertical line which has very little tremor or lateral deviation in it. (4) When the eye makes the big saccadic movement it frequently stops short of reaching the mark and a corrective movement is required. See points 1, 2, 3, and 4 marked on record B. The amount of time elapsing before the corrective movement is executed is one reaction time (about .16 second). The retinal field must clear up, visual impression must become distinct, and the individual realize that he is not seeing the desired fixation point with greatest clearness—only then will he move the eye over.

We may suppose that this last characteristic, the corrective movement, is present only when one desires to reach visually a specific point in the field. When visually exploring surroundings at the street crossing, we probably make none of these corrective movements (see record A). On the golf course, however, I look to one side and then want to look back at the flag, whereupon my eye will execute the main jump to the vicinity of the flag and then a short movement to bring me exactly on it. The normal pattern of eye movement, in fact, resembles golf—I make a long drive to reach the green, and then a putt to sink the ball. But the eye makes no preliminary false motions.

The person who made record C, Figure 3, began (see bottom of record) with a fair amount of care. This is shown by the corrective movements the first and second time he fixated the left-hand mark. Later he contented himself with whatever position of proximity to the dot his eye happened to reach with the first movement. In record D this same young man attained even higher speed and made even shorter fixations. In no case in this latter record did he make a corrected movement. We notice that his successive fixations at the right line up vertically fairly well, that is, he found the right hand dot with fair accuracy. The fixations on the left show quite a a little deviation, a maximum range of about five degrees. Not many individuals can move the eyes as rapidly as did this man. Each dot represents .01 second and the stretching out of the dots on the record is due to the speed with which the eye is turned.

ANOTHER man in record E shows far greater inaccuracy in carrying out the fixations. He grossly neglected the instruction, "look at each dot distinctly," and sometimes, as at 5, 6 and 7, he did not go near the prescribed dot. All of these records from bottom to top required about seven seconds. These records have familiarized us with the main features characteristic of saccadic eye movement measurements using a standard distance of 40 degrees of visual arc.

In Figure 4, record F is given as representing an ideal eye-movement test result. This includes two tracings, 1 and 2. The movements were direct and quick, they indicate an attempt to be exact, which is shown by the corrective movements. The fixations after correction show that the individual consciously and precisely saw the mark—he was awake and alert.

Now let us turn specifically to the records made by our typist subject mentioned above, who was *very sleepy*, having grossly transgressed the sleep instructions agreed to for the evening

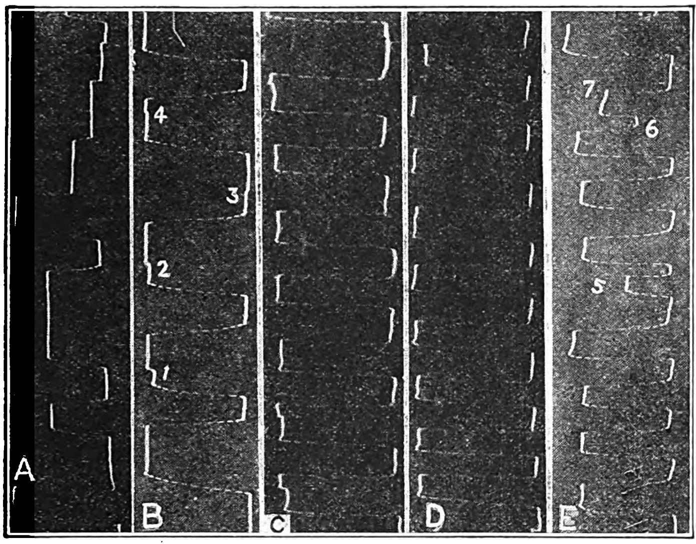

FIGURE 3

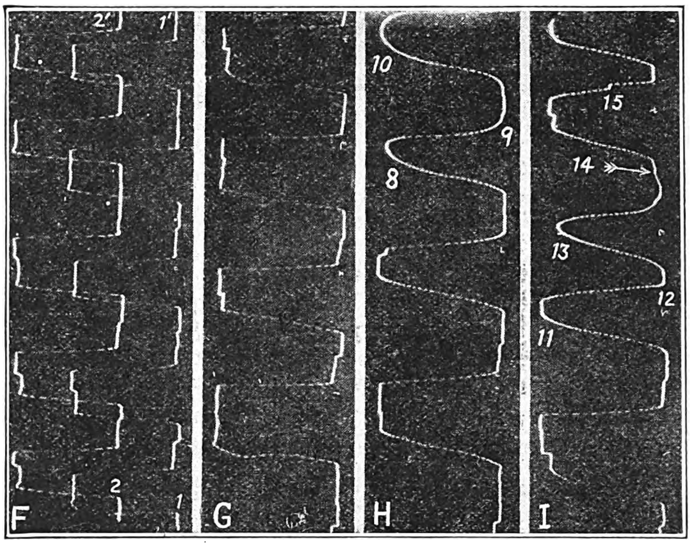

FIGURE 4

experiments on typewriting. He talked and laughed and tried to bluff himself and the experimenter into the impression that he was "peppy." Notice what the eye-movement camera caught! Record G, Figure 4, was made at the beginning of the evening. It is in marked contrast with the normal (see F) in two particulars: First, the movements are much slower (many more dots to cover the same distance than used in F); second, the movement lines, particularly the one at the bottom and the one next to the top, are curved, indicating that the eye rolled up. In nearly all cases a corrective movement was indeed made and the points were fixated accurately without much wavering of the eyes.

NOW when we take him two hours later, during which time he has been employed at a variety of typing and other light tasks, we have record H. Starting at the bottom it will be seen that the first movement, although wavering, is fairly direct but is *very slow*. The time required is about .25 second, more than twice as long as the usual time for this visual-motor act. The fixation at the left which resulted was preceded by a small corrective movement and was apparently adequate and steady. The next movement was to the right. This was considerably quicker, but much slower than is usual for such movements (see records B, F, and also G). The next movement to the left (third dotted line from the bottom) is very slow and has no corrective movement. Following a short fixation there is a small jerk to the right, which is an oddity in such tracings. The movement to the right (fourth dotted line from bottom) terminates very slowly and no corrective movement appears. The fixation line is not truly vertical but wavering. From this the next movement begins with fair promptness, as witnessed by the moderately sharp turn to the left, but the movement is executed at a snail's pace, as shown at the right of 8.

Now (at 8) occurs a change which so far as I know is entirely new in the description of saccadic eye movements. The movement converts itself into a pendular swing or roll of the eye from side to side at a very slow rate. There is no moment of holding the eye steady for fixation, there is, in fact *no seeing*. The retina is insensible, the visual centers are inactive, the individual is asleep. His eyes are open, they continue to move for awhile (swing over to 9 and back to 10) under the drive or perseverative tendency of the regular muscular action just engaged in, but the movements are without point or purpose. They take the eye here and there while the eye, insensitive, sees nothing anywhere. The man urging himself and psychologically whipping himself to keep awake has kept his eyelids open but has not succeeded in keeping his retina active or his visual centers awake.

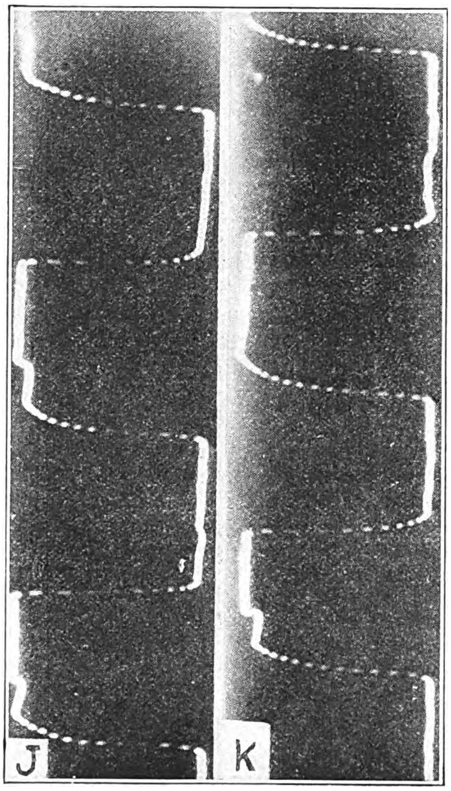

FIGURE 5

Our same sleepy typist made record I. This started with a wink which cut off the light. There was a corrective movement and wavering fixation following at the left. The first movement to the right was slow. It was followed by a slow corrective and a wavering fixation, if it may be called fixation. The typist was apparently not quite asleep; his eye did stop, when he reached points 11 and 12, but after 12 and especially at 13 he was quite oblivious to retinal impressions. During the slowed up period of eye movement at 14 there was partial arousal of his visual centers. He wakened probably at or about the position of the arrow. The eye crossed to the left fairly directly but very slowly; there is a corrective movement and some fixation. Then the typist sinks again into sleep, the movement to the right is interrupted by a short break at 15, there is a pause at the right-hand mark and then the rolling movement starts; he is asleep, and the record here terminates by the closing of the eyelids.

THESE two records prove conclusively that it is possible to go to sleep when the eyes are open, even if the individual is strongly motivated to stay awake. They are exhibits which indicate that retinal sensitivity is of chief importance in defining wakefulness. The movements of the eyes have no important function other than that of directing the eye so that images of particular points and outlines can fall on sensitive receptors. Ordinarily, when we invite sleep we inhibit eye movements, close the lids, and reduce the stimulation to a minimum, but this is not the cause of sleep as a psychological state. Sleep may come on while the eye movements are going, the lids

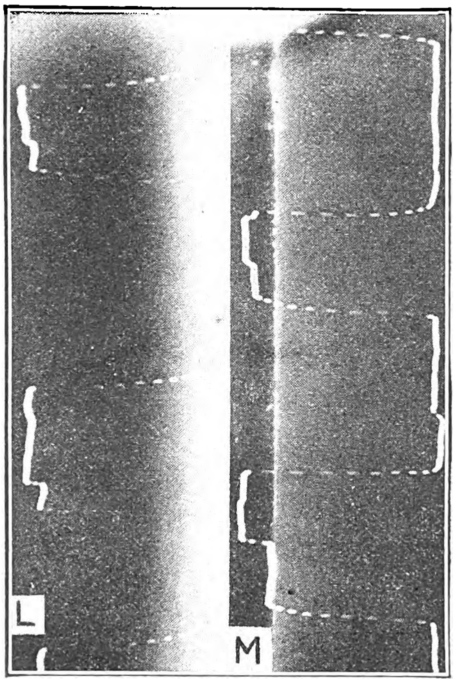

FIGURE 6

open, and the individual striving to proceed with his visual task.

There are a number of criteria which we may use as indicators of profound sleepiness and which are revealed by certain of our photographic records. Dr. H. R. Laslett⁽²⁾ carried out an experiment on the effects of the loss of sleep at the Psychology Laboratories, Stanford University, in 1926 under the direction of the writer. He had a group of men stay awake for a period of 72 hours. Many different kinds of measurements were made on these individuals and a few eye movement records were taken. Most of these latter were failures due to a misunderstanding in reference to the photographic materials employed. A very few of these records taken about 66 hours after wakefulness began may be shown as illustrating certain of the criteria of sleepiness.

The pair of records reproduced in Figure 5 show slow speed of movement as our *first criterion*. The movements to the left are .13, .16, and .16 second. Those to the right are .11 and .13, respectively, for record J. In record K movements to the left are .14, .14, .15; to the right .11 and .11. These are seen to be slow when we compare them with the usual average of .11 for movements to the left and .10 in movements to the right. The slowing occurs especially in moving to the left.

The *second criterion*, wavering fixation, is also demonstrated by Figures 5 and 6, particularly in L where occur, at the right, curious temporary deviations in fixation.

Criterion three is interference or failure in reference to the ordinary corrective eye movements. As an illustration, see record M, Figure 6. The first corrective, bottom of the record, is abnormally large and, in fact, so large that it is followed by a small corrective in the opposite direction. The next movement, first to the right, is too large and has to be followed by a negative correction. The second fixation at the left has first a positive movement and then a small movement of corrective nature in the opposite direction. Similarly these oddities in corrective movements are seen also in the records of Figure 7 and particularly in record P of Figure 8, where at the left the individual makes pairs of corrective movements in the same direction.

Criterion four consists in breaking the long saccadic movement into shorter movements, that is, interrupted saccadics. Records N and O of Figure 7 are examples of this. These short, nearly vertical lines which occur about midway between the right-hand and left-hand terminals of movements are, so far as I know, peculiar to the condition of profound sleepiness. A short break of this nature occurs near the top of record I, Figure 4, made by the sleeping typist. Notice that these breaks are not accompanied by corrective movements. The individual is not trying to see any specific point.

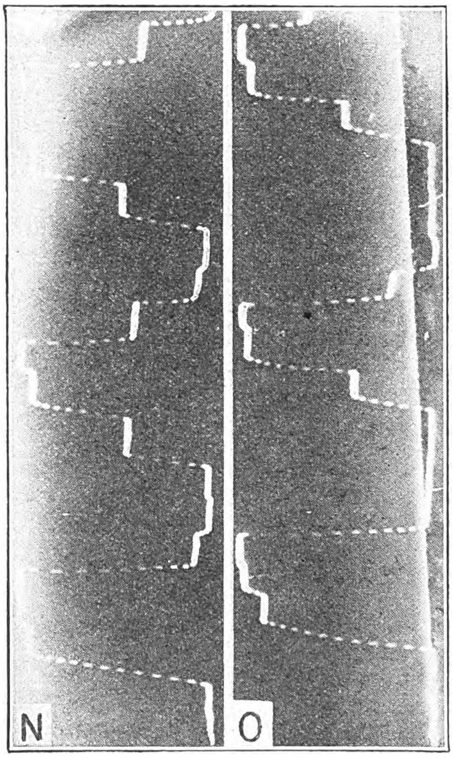

FIGURE 7

Criterion five is the change from the typical saccadic jerk of the eye to the rolling, pendular type of movement. This is unaccompanied by a perceptive fixation; the eye does not stop and it does not see. This tendency shows first as a very slow termination of the usual saccadic movement. See top of the chart designated by Q in Figure 8.

The quick-moving, steady-gazing, well-opened eye, denotes the confident, wide-awake person. The slow-going, gaze-shifting, dull eye, somewhat rolled up so that the upper lid half covers the pupil, tells us that the possessor is drunk or drugged. So in a general way we recognize the symptoms of profound sleepiness. In this state, vision is dim (sensitivity of the retina is less than normal) and we might say insecure (it is hard to maintain fixation). It is difficult to keep on the line of print, the eyes close up shop even though we ourselves have declared for another hour of business, and we have to use the whip to get overtime service.

Study of the eyes during profound sleepiness and at the moment of falling asleep is a new field of research. At present we do not know enough about it to give a temporal sequence for the appearance of these various criteria of sleepiness. We do not know whether certain of them are especially typical for certain individuals. Our experiments, which in general must be made as circumstances offer opportunity, have clearly shown that the eye-movement records of the sleepy give marked differences from those made by the wide-awake. The sparkling eye is the quick, steady eye. The eye of the sleepy glides, wavers, and is fitful in its "hold" on the important objects of the environment. Sleeping is not primarily a condition of closed or open eyelids but of the retina and the visual centers. Just because we can see the open eyes of a person is no reason why we should testify in court that "he was wide-awake."

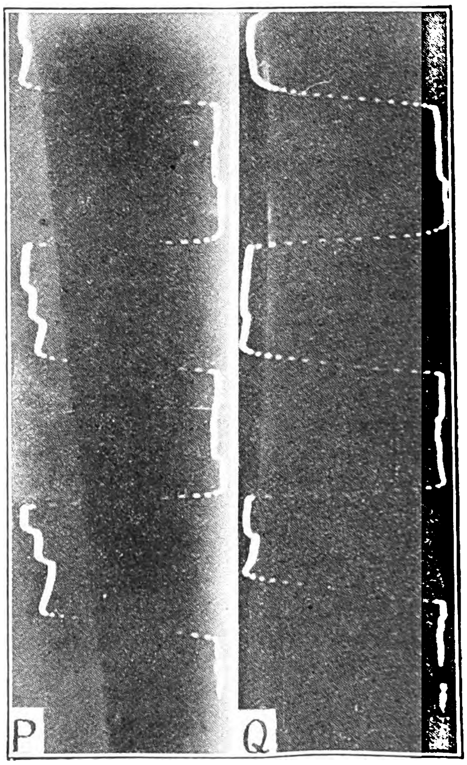

FIGURE 8

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2. H. R. Laslett, "Experiments on the Effects of the loss of Sleep," *Jour. Experimental Psychol.*, October, 1928, p. 370.

OUR POINT OF VIEW

S. O. S.

IN October, 1797, there was launched at Hartt's shipyard in Boston a frigate that was to make history. Named the *Constitution* and later affectionately called *Old Ironsides* in tribute to her staunchness, perhaps her best known service was the subjugation of the tribute-levying Barbary pirates of Tripoli in 1804, but she fought many other victorious battles and captured many men-of-war. Some of the finest, most glorious traditions of the United States Navy are enshrined in her small bulk.

Although she survived a century and a quarter, she seemed destined for the junk pile a few years ago. In 1925 Congress authorized her restoration by public subscription and the work was started. Lithographs of her were sold to raise funds. That was insufficient. Now, solid old oak from her hull, copper from her sheathing and bolts, and lead from her magazines have been utilized in making historical souvenirs, appropriately and beautifully stamped or molded to show the source of the material. There are paper knives, cigarette boxes, ash trays, small cannon, anchor paper weights, et cetera; and one of these will be given to each contributor to the rebuilding fund. The lithographs are still for sale, and there is also a set of plans for sale, giving instructions for building an exact model of *Old Ironsides*. All these have been designed in order to collect the funds necessary for completing the job.

Back this worthy undertaking to the limit. Send your dollar, five dollars, ten dollars, or what you will, to District Staff Headquarters, First Naval District, Navy Yard, Boston, Massachusetts, and ask for a catalogue of the souvenirs. Remember, *Old Ironsides* was a most valiant ship in her day and, as the Navy says, "Save Old IronsideS is the only S.O.S. she ever knew!"

The Layman Learns

SOME of us are inclined to scoff at guide books but in Oklahoma "guide books" of a different kind are gaining the attention of thousands. These are in the form of signboards along a highway leading out of Ardmore and, very strangely, are descriptive of the various geological formations exposed on the surface of Arbuckle Mountains. It is said that, with the exception of glacial and volcanic phenomena, almost the entire gamut of geology may be observed in these mountains. The signs were placed by the Ardmore Lions Club and the Ardmore Geological Society, the moving spirits in the undertaking being Drs. Charles N. Gould and C. W. Tomlinson.

At first glance, the attempt to interest the layman in geology in this unique manner would seem to be futile. But in Oklahoma, geologists are no longer looked upon as pedants. This is due mainly to the facts that Oklahoma ranks second among the states in mineral production, ranked first last year in oil production, and that geologists are largely responsible for the discovery of the 300 oil fields in the state. It is said that it is not uncommon to find dozens of cars lined up at the signs while their passengers study them. "Thus, in Oklahoma," said Dr. Gould recently, "we are humanizing geology."

Science is such a matter of every-day concern that we heartily approve of this movement. It is to be hoped that it will extend to other states, be enlarged upon, and improved to humanize a wider field of scientific study than geology. The layman has too often been accused of shallowness. We believe that, if given a chance to find out about the things with which he comes in contact every day, he will prove up nobly. He has in Oklahoma and he will elsewhere. Tell him what he wants to know.

Television's Future

TELEVISION is a subject which intrigued the popular imagination for many years before successful demonstrations of the art were carried out. Now, therefore, that the science of "seeing by radio" has been demonstrated as being practicable for use by persons not highly versed in the technical side of radio, a word of warning seems propitious. Dreams of life-sized images at a television receiver are all right in that they may serve as inspiration for further developments, but sometimes they may serve to delude those who will, in the final analysis, be the greatest users of television. We speak of the general public.

On another page of this issue, we present a description of some of the latest advances in television technique. We tell of home television receivers. But don't get the wrong impression. The television images which can be received today are small and crude. They bear little resemblance to the "radio movies" which are fancifully pictured by some. But they are a step forward. The future holds promise of big things to come, but these big things are not here as yet. We hope that many of our readers will become interested enough in television in its present stage to build experimental receivers and "look in" on the programs being broadcast. It is in this way that the greatest progress can be expected—by contant experimental work under actual field conditions.

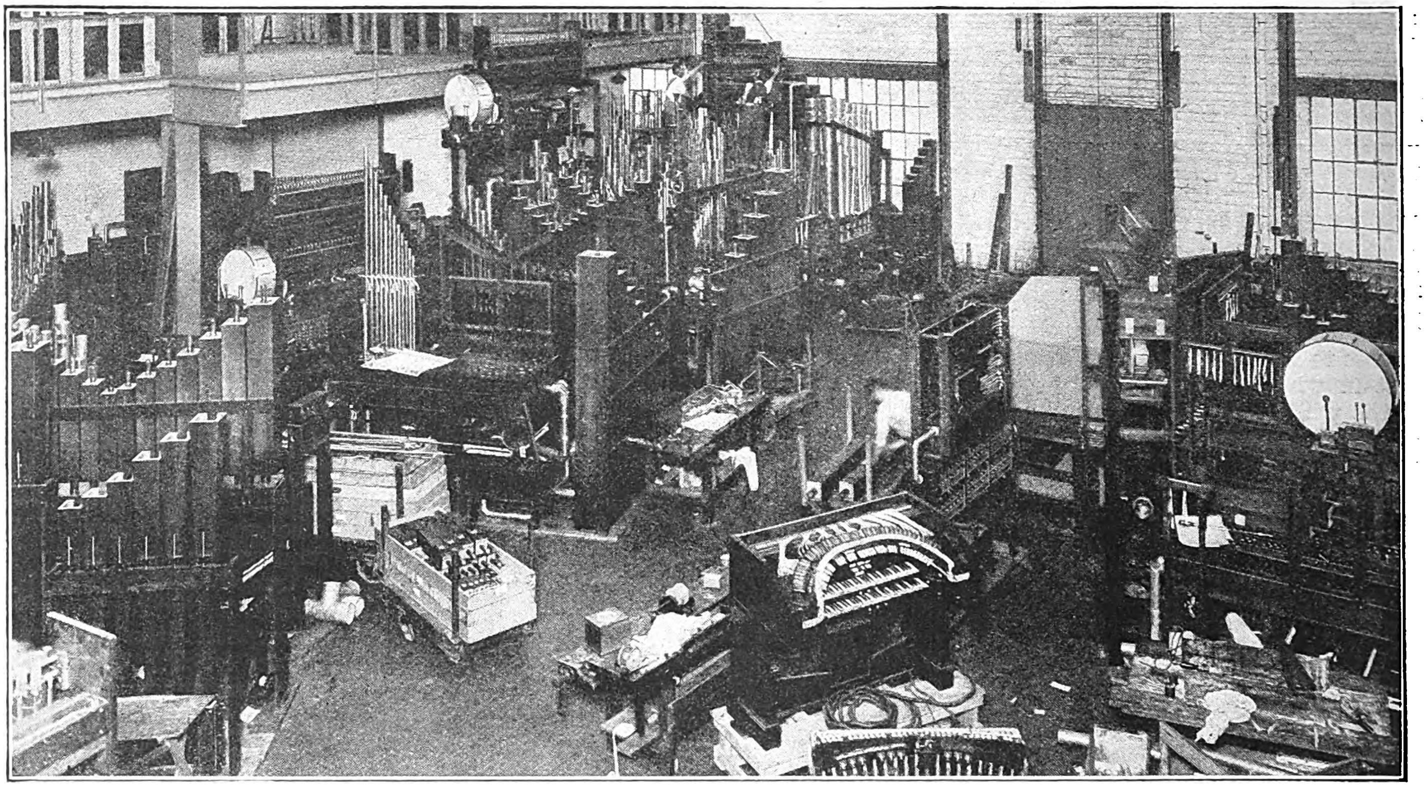
Submarine Safety

THE special board appointed by the Navy Department nearly a year ago to investigate submarine safety devices and schemes has just completed its task and rendered a complete report. Following the tragedy of the *S-4*, 4971 such ideas were submitted to the navy by people throughout the country. Most of these were quickly thrown out as being of no value or impracticable but 353 of them were selected for further study. Several of the latter have been approved by the board.

Most important of the approved devices is the "artificial lung" by means of which not only divers but officers as well have "saved" themselves without outside aid. Naval experimenters using the "lung" have brought themselves to the surface from a depth of 155 feet by climbing hand over hand, slowly to prevent divers' bends, on a line tied to a floating buoy. The "lung" is similar to a gas mask and contains oxygen and soda lime.

Lifting eyes on submarine hulls have hitherto been frowned on but the board approves them. The board approves double tubes in submarine hulls, for delivering fresh air, food, and water to imprisoned crews. It also sees value in the diving bell which can be placed against escape hatches to receive a number of men and bring them to the surface, but recommends further tests. Of the other devices suggested, detachable escape chambers would add too much weight; powerful magnets to lift sunken submarines are impracticable; and submarines specially designed to rescue crews of sunken submarines are of doubtful value; consequently, schemes such as these were disapproved.

It will be seen, therefore, that the navy is keenly aware of its most vital problem and is open-mindedly considering every possible solution. Experience has been such a hard teacher that the navy has determined to prevent, if possible, any repetition of the tragedy that befell the *S-4*, and to that end will continue to investigate and experiment. Hereafter, if a submarine sinks in reasonably shallow water, it is anticipated that the men, if still alive, may quickly save themselves or be saved without delay.



All photographs courtesy Rudolph Wurlitzer Company

ALL THE ELEMENTS ARE ASSEMBLED IN THE ERECTING SHOP

The hundreds of pipes, the cables with their miles of wire, the drums and other actual instruments which are to be incorporated are all brought together and correctly assembled. Air at various pressures is available at all points in this room where the organs are tested

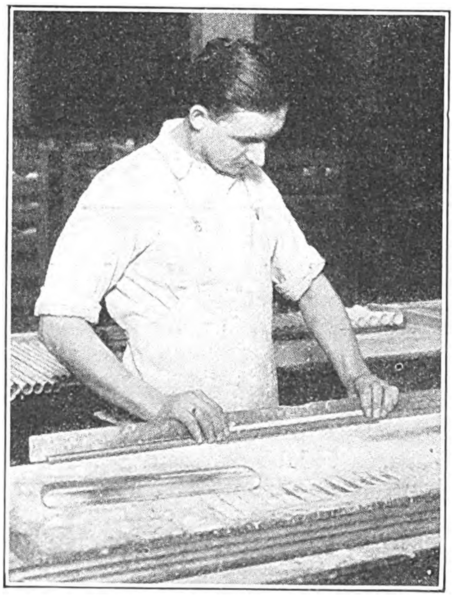
Modern One-Man Orchestras

Organs for the Church, Theater, and Home Require Skilled Workmanship if They Are to Render Good Service

By **ALBERT A. HOPKINS**

THERE was a time when every theater had an orchestra of at least four or five pieces. Sometimes the music was good; but often it was indifferent. The public wanted something better, and the demand was met by the "unit-orchestra" which combined a cathedral organ with an orchestral section. Later, a novelty and percussion department was added, thus combining into one all the different voices of the symphony orchestra—wood-wind, brass, percussion, and string. The organist has under his control a phantom orchestra and an organ which makes it possible to play any kind of music, especially that which requires rapid technique and quick response that was not possible in the old-time organ.

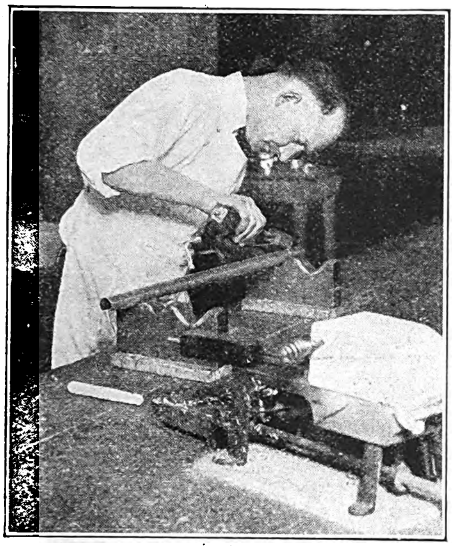
THE great development of the moving picture has both helped and harmed the musician. It could perhaps be expressed as follows; it eliminated the mediocre musicians and gave the competent ones prestige and good salaries. The movie houses waxed prosperous and the seating capacity has risen from two or three hundred to five or six thousand. What is more natural than to supply a great symphony orchestra of, say, 115 pieces when dollars are streaming into the ticket booths by the thousands? Audiences like to see a splendid orchestra come up from the pit playing "Pomp and Circumstance," or some other musical masterpiece. Of course, the orchestra cannot play all the time, particularly when the picture is on, so that here is where the unit-orchestra comes in. Often as the orchestra pit sinks with the musicians still playing, a console rises with the organ expert carrying on.



NO MASS PRODUCTION HERE

Each metal pipe is made by hand. The workman is shown "rolling up" a tube

IN other days organs were built according to the service they had to perform. A church organ was in use only about four or five hours a week while a "movie" house might operate the organ for three times that period every day, seven days a week. The ordinary organ would not "stand the gaff" and it was soon discovered that a new order of musical instrument was necessary. This condition led to the gradual evolution of an organ which would render satisfaction under severe usage. It is this type of instrument that the writer will describe. As you pass along the Falls Branch of the New York Central, just before you reach North Tonawanda, you see a station marked



SOLDERING THE PIPE

The pipe having been formed is soldered and is then ready for "voicing." See below

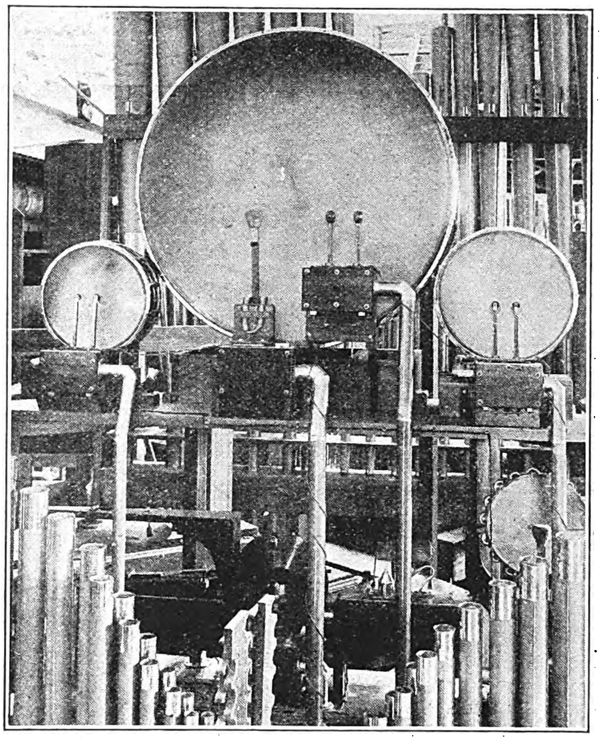
"Wurlitzer," and here these organs are fabricated. The writer spent a day in the factory and the processes were found to be so interesting that we will describe them to our readers.

An organ with the orchestral additions is a very complex piece of mechanism involving thousands of pieces, miles of wiring, and a constant and intelligent supervision. Curiosity is often evinced as to what things cost. When you go to a first class movie-house you may be listening to an organ which costs anywhere from 15,000 to 60,000 dollars and, in some cases, nearly 100,000 dollars is involved. It is only when you see the organs fabricated that you can form any conception of the painstaking care which produces the finished instrument. The organs are all assembled and tested and are then boxed and sent to their destination; if to a foreign country where there is no representation, an expert is sent from the factory to supervise native talent. In some localities an organ would literally be "eaten up" by ants or other insect pests, but this is guarded against by importing from that country wood which is immune, and the leather for the bellows is "poisoned."

ORGANS are designed according to the work expected of them. One intended for a broadcasting studio has the base constructed along different lines from a church or auditorium organ. An instrument for a private house, particularly where there are young and lively people, is apt to be a small edition of the moving-picture house type. Drummer's traps are freely introduced and as the musical talent may lie dormant, the music is often controlled by a perforated roll. An organ for a mortuary is divorced from many of the more florid features usually provided.

An organ, while not as temperamental as a prima donna, does have to be tuned and in a great "movie" house, where the duty is heavy, it is gone over about every week or ten days. Inequalities of temperature is the cause of the pipes getting out of tune. An organ is a long-lived piece of mechanism if carefully looked after.

The heart of the organ is, of course, the pipes, which are made both of wood and metal. It would be manifestly awkward to build a 32-foot "diaphone" out of metal. Therefore, wooden pipes are made of California sugar pine, but some of them, as the flutes, have a hard wood front. After the wooden pipes are made they are "voiced" to give pitch and tone, often with their metal brothers. The metal pipes are made from sheets of tin alloy cast on long linen covered stone tables, smooth as a billiard table, and, in fact, similarly built. Nothing but block tin from the Malay Straits and pure pig lead enters into the composition of the alloy, varying proportions being used according to the tone to be produced.



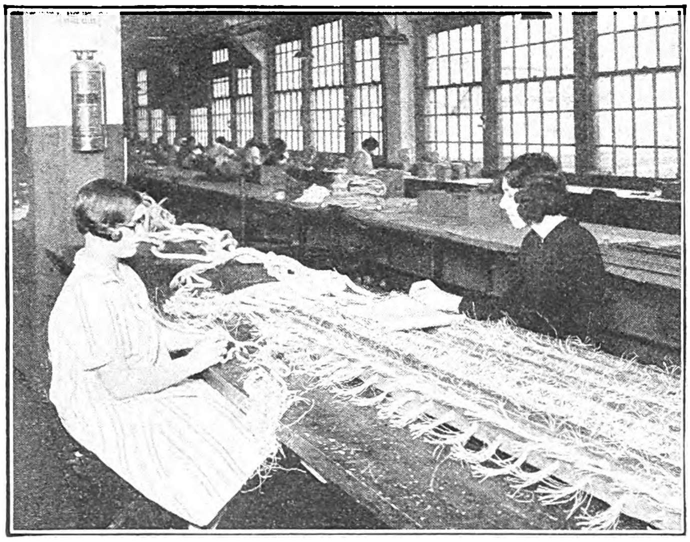
ACTUAL INSTRUMENTS OF PERCUSSION

Drums, tambourines, cymbals, sleigh bells, castanets, et cetera, are introduced into the organ itself, giving better results than simulated effects of the instruments

One of our illustrations shows a pipe maker rounding up the metal body of a violin pipe. After the metal has been cut to scale from the sheet, the pipes are rounded into shape by beating the metal around steel mandrels. Each stop has a minimum of 61 pipes, all of which are of different lengths and diameters, and, in addition, each stop is different from every other; therefore hand work is absolutely essential in the making of metal pipes. The pipe,

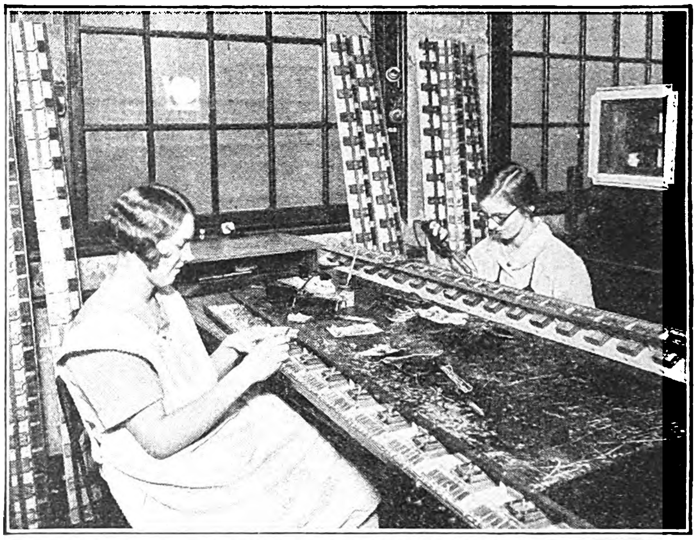
VOICING THE PIPES

The pipes, whether wood or metal, are "voiced" and tuned by experts who compare the new pipes with standards. The mouths of the metal pipes are carefully adjusted by cutting



"RINGING OUT" A CABLE

The cables are all specially formed for each particular organ and are "rung through" or tested as shown before being covered



SOLDERING THE CABLE

The electrical supply wires are soldered to the silver contacts for the electrical action. The requirements for accuracy are rigid

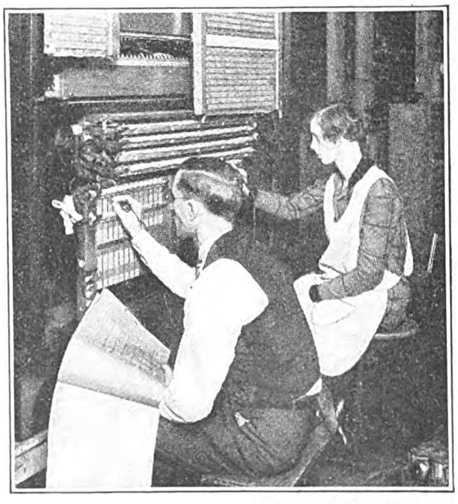
having been formed, is then soldered and is ready to be "voiced." This is the most particular branch of organ building and is carried on in special rooms, of which there are 18 at the Wurlitzer plant. The "voicer" is shown treating an open diapason stop. It is necessary to cut and prepare the mouth of pipes, and one of our illustrations shows an expert cutting a pipe, such as a diapason of violin or flute. In the case of the small pipes a magnifying glass has to be used, the work is so fine.

Other elements which are all essential to the functioning of an organ are the means for supplying wind pressure, control of the air at the individual pipes by means of electricity, and the keyboard or console. The electro-pneumatic action is absolutely reliable, as it has stood the test of time, having been used in organs for over 30 years. It is instantaneous in attack, and is capable of far faster repetition than is possible with the human hand.

THE cable-making department is of special interest. Here miles of wire are cut and spliced so that the behests of the organist are conveyed by these "nerves" to the electro-pneumatic action. One of our illustrations shows a relay cable being tested. In another illustration, girls prepare and solder the electrical supply wires to the silver contacts that are used exclusively for the electrical action in these organs. After final tests the cable is taken to the erecting room for its incorporation in the organ proper.

The console or keyboard is an elaborate affair and requires complicated wiring so that the cable may connect the player's keys and stops with the pipes, drummer's traps, et cetera. The parts of the organ are now collected from the various departments and sent to the erecting shop where all organs are assembled and tested electrically, mechanically, and tonally. In the photograph at the top of page 494, several organs can be seen with the pipes on the chests; others show the chests that have not yet received the pipes. In the foreground can be seen a console composed of two manuals or keyboards, with the stop keys arranged in a semi-circular fashion above the top row of keys. The pedal board, which is operated by the feet, can be seen standing in front, ready to be attached to the console. The cable connecting the console to the organ can also be seen coiled on the front of the platform on which the console is standing.

Organs of three and four manuals are usual, and even five and six manuals have been built, but these last without marked advantage in these days of simplified control. Wind at various high and low pressures is conveyed from the blower-room to outlets situated every few yards in the erecting room floor for testing and playing the organs as they are erected. Testing and playing current is similarly distributed to all parts of the erecting room. Freight cars are rolled into the adjoining enclosed shipping room and loaded with the aid of the traveling crane, without exposure of organs or workmen to outside weather conditions.



"RINGING OUT" ON A CONSOLE

Test of wiring before the console goes to the erecting shop to be connected to pipes

One of our photographs shows drums, cymbals and tambourines. These drums and traps are genuine orchestra and band instruments, not merely means of imitating them. In fact, in some instances they are better and more costly than standard instruments, as, for example, the bass and side or snare drums made with automatic spring tension applied to the drum heads to keep them in playing condition through changes in humidity or temperature, an operation performed by the player in an orchestra, who often changes the adjustment several times during a single concert.

THE tom toms, Chinese gongs, Persian cymbals, and some of the other instruments are imported from the lands where they are the source of native music. Such orchestral elements do not enter into church and residence organ construction, although the harp and chimes of tubular bells are desirable, and are usually found in such organs. Moving-picture houses require all these elements and often many more such as sleigh bells, xylophones, castanets, triangles, glockenspeils, and vibrating bells.

The entire instrument is operated by one musician from a console placed in the orchestra pit or in any location desired. For motion pictures, this is a great advantage, as the operator is able to follow action upon the screen in such a manner as to make it perfectly realistic. In the larger houses the console is often placed on a platform which is raised or lowered by a motor and the orchestra is handled in the same manner.

The Strangest Thing in Physics*

Why Water at Its Boiling Point Weighs a Little More Than at a Freezing Temperature. Old Concepts, and Even Laws, Are Broken Down by The New Physics

By PAUL R. HEYL, Ph.D.
Physicist, United States Bureau of Standards
Corresponding Editor, SCIENTIFIC AMERICAN

THE scientist sat at his desk reading a letter. He read it through twice, and then, laying it down, looked out of the window in a brown study. This is what the letter said:

"I regret taking up your time, but I am in intellectual trouble. I have been a high school teacher of physics for 35 years, and I have always tried to keep informed as to the progress of science. This has been difficult at times, but I have managed after a fashion.

"Contrary to what you may suppose, it is not the Einstein theory that is troubling me. That seems so strange and bizarre that we may expect almost anything from it, just as we would not be surprised at any erratic behavior on the part of a visitor from, say the kingdom of Prester John. But if one of my fellow townsmen, of established reputation, and whom I have known all my life, should begin to behave strangely, I should be much concerned.

"I learned my physics in the 19th Century, before the discovery of X rays, and I was taught that matter was indestructible. This principle I, with all others of that day, regarded as a main pillar of the temple of science. And now—am I not correct?—I understand that this principle is no longer held to be valid; that matter may actually disappear, be annihilated. This, if true, is to me the strangest thing in physics.

"SURELY such a revolutionary doctrine must be founded upon the very best of experimental evidence; and here I am puzzled again, for I cannot find what this evidence is. All that I can learn seems to indicate that this doctrine is only a theoretical consequence of something in the Einstein theory.

"Now I know that you and others would not have accepted this doctrine unless the evidence for it was satisfactory to you. Please straighten this out for me, for I am really in an uncomfortable state of mind."

"Thirty-five years!" said the scientist, softly. His own hair was gray. He drew a sheet of paper toward him as though to answer the letter, but stopped and looked out of the window again, pondering a suitable answer.

"I wonder," said he, "how many more such persons there are. Perhaps I had better write an open letter."

And he did. This is it.

MY DEAR SIR:

I can appreciate the difficulty in which you find yourself, for my own student days date as far back as yours. When a man passes middle age it becomes increasingly difficult for him to see the force of the evidence for anything revolutionary. Some few fortunate individuals retain their mental plasticity to the end of their days, but most persons find it not only difficult but distressing to unlearn what was taught them in their youth. Agassiz never could bring himself to accept the doctrine of evolution; and Kelvin found great difficulty in believing that the energy emitted by radio-active bodies came from within the atom.

LAVOISIER

His work laid the foundations of the principle, long unassailable, but now modified, of the conservation of matter

You are correct in your statement that the principle of the conservation of matter is now regarded as only approximately true. The 19th Century experimental evidence for this principle remains just as good as it ever was. The fact is that the departure from this law is far too small to be picked up experimentally.

You are familiar with the classical experiments of Lavoisier and others; how we may burn something in a closed vessel and find that the weight of the vessel with its contents is, as nearly as we can tell, the same before and after the combustion. You have had impressed upon you that if we take into account all the substances included in a chemical reaction there is, on the whole, no gain or loss in the total mass. You have also learned that there is no change in mass as a consequence of physical changes, such as the heating or cooling of a body, or the change of state from solid to liquid, or liquid to gas.

Modern physical theory declares unhesitatingly that such statements are but close approximations. Just how close they are to the truth may best be understood by a few illustrations.

Water at its boiling point weighs a little more than at a freezing temperature. The difference is about five parts in a million million. For most other bodies the difference is still less.

The freezing of water involves also a slight decrease in mass, amounting to about three parts in a million million. This again is an extreme case, the solidifying of most bodies involving a smaller change in mass.

AS an illustration of the same effect in chemical action, consider the formation of water from oxygen and hydrogen. The weight of the gases before uniting is greater than that of the resulting water by about one part in six thousand million. For most chemical reactions the difference is much less.

Radio-active changes may give rise to greater differences, amounting to as much as one part in ten thousand, but such changes are completed only after long periods of time, of the order of thousands of years.

Such changes are far beyond our ability to weigh. By the greatest of care, and by using comparatively large masses, we may perhaps attain a precision of one part in a thousand million.

At this point you will naturally ask how we can be so precise in our estimates of this very small loss in mass if it so far transcends our ability to weigh it. The answer is that it is a matter of calculation from theory. And permit me to postpone for the moment any discussion of the foundation of this theory until I have explained its nature.

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*Publication Approved by the Director of the Bureau of Standards of the U.S. Department of Commerce.

In each of the cases that I have mentioned, whether physical or chemical, there was an evolution of energy. The hot water cooled down, radiating away heat. The freezing water gave out its latent heat of solidification. The explosion of hydrogen and oxygen liberates more heat than most chemical reactions, and the continual development of heat in radio-active bodies was an experimental fact that sorely puzzled Kelvin.

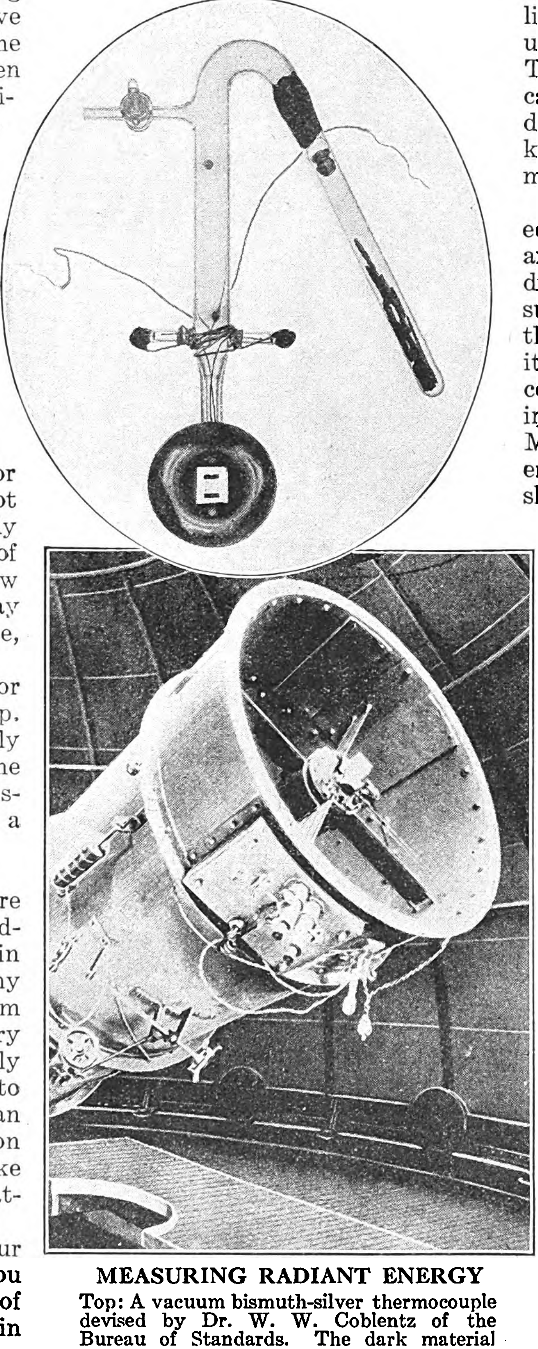
Modern theory states that in every case of a loss of energy there is a proportional loss of mass. It seems that energy itself possesses a little mass which it carries off with it when it leaves. This mass equivalent of energy must be regarded in very much the same light as we regard the heat equivalent of energy. It has been recognized for about 70 years that for every 778 foot pounds of work that may apparently disappear, one British thermal unit of heat makes its appearance. We are now accustomed to the idea that work may be converted into heat with a definite, fixed ratio.

But this was a difficult concept for the physicists of other days to grasp. And we of today are finding it equally difficult to accustom ourselves to the idea that mass may apparently disappear, to reappear as energy in a definite ratio.

OUR problem is somewhat more difficult than that of the mid-Victorian physicist, for the ratio in this case is very small. It takes many more units of energy to equal a gram of mass than it does to equal a calory of heat. As a matter of figures, only 4.2×10^7 ergs of work are required to make a calory, while no less than 9×10^{20} ergs (about 20 million million times as many) are necessary to make up the equivalent of one gram of matter.

A simple calculation, which your knowledge of physics will enable you to make readily, gives the changes of mass which I have stated to occur in each case which I have cited.

It may perhaps suggest itself to you that in the astronomer's laboratory we might find instances of loss of mass which would be large enough to measure, such as the radiation of heat by the Sun. It is true that the total heat radiation of the Sun is enormous, but 9×10^{20} is a very large number, too. Calculation, however, tells us that the Sun is losing mass by radiation at the rather surprising rate of four million tons per second! This, however, is not so easy to detect as might appear. The only way we have of detecting any change in the Sun's mass is by an alteration in his gravitative pull on the Earth and the other planets. This pull is due to the whole mass of the Sun; and, large as four million tons per second may appear in itself, the Sun's total mass is so super-enormous that only after 10 million years at this rate of expenditure would his total mass (and his attraction) be reduced by one millionth!



MEASURING RADIANT ENERGY

Top: A vacuum bismuth-silver thermocouple devised by Dr. W. W. Coblentz of the Bureau of Standards. The dark material inside the tube is metallic calcium to absorb traces of residual gas. Bottom: The same thermocouple in place on the Lick reflecting telescope. Courtesy Lick Observatory

We are therefore at present without any experimental means of checking theory. Nevertheless, I and others accept this theory, and the reason for this I will now try to make clear.

It is a fact, as you mention in your letter, that the doctrine of the equivalence of matter and energy was first announced by Einstein as a mathematical deduction from his theory of relativity; but within a short time he saw that this new doctrine had also a purely classical basis which carried it back to Maxwell and even to Newton. You and I, sir, found Maxwell's doctrines already classics when we were in college. One of these doctrines was that light will exert a very small pressure upon any surface which it encounters. The amount of this pressure as indicated by theory was too small to be detected in Maxwell's day, but, as you know, it has since been observed and measured by several experimenters.

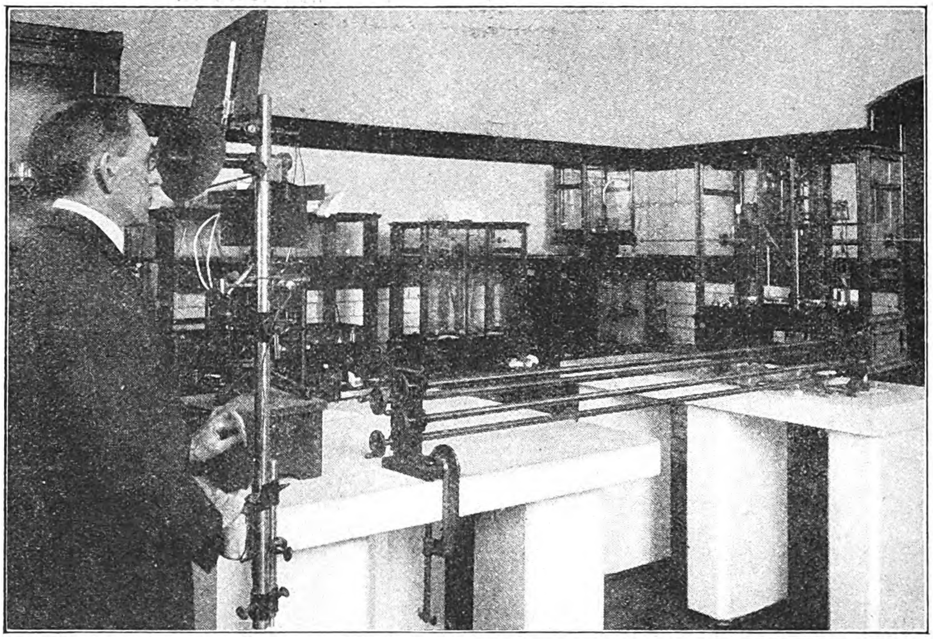
We must now remember Newton's equally classical principle that action and reaction are equal and in opposite directions; that if a body exerts pressure when we try to stop it, it will by the same token require a force to start it, and that there will be a kick or recoil of the pushing mechanism. Joining these two principles of Newton and Maxwell, we conclude that anything emitting a flash of light will recoil slightly as the light leaves it. In other words, light energy behaves just as though it possessed a little mass.

Now, while the pressure of light upon a receiving surface has been measured, the recoil of the emitting source has not yet been experimentally observed. The difficulties are still too great. Yet no one who accepts the classical mechanics can doubt the existence of such a recoil. It seems strange that Maxwell did not think this far. He pointed out the existence of light pressure at the receiving end, but it remained for Einstein, a generation later, to complete the theory by discussing what happens at the emitting end. In other words, Maxwell recognized that light possessed momentum, but Einstein was the first to show that it also possessed inertia. It is for this reason that this new idea is sometimes called the inertia of energy.

RADIANT heat, as you know, is of essentially the same nature as light, the only difference being one of degree. Its wavelengths are too long and its vibrations too slow to affect the eye. All that has been said of light must hold good for radiant heat. Maxwell's theory of light pressure is in no wise dependent upon the wavelength. It follows then that radiant heat must possess a little mass, to this extent behaving like a moving particle.

Let me here remind you of the very recent theory of wave atoms, which seems to be carrying us toward some kind of a union of the wave and particle concept.

Einstein summarizes his whole argument as follows: either we must admit the equivalence of mass and energy or we must abandon the whole structure of classical mechanics.



"HE MUST HAVE A LONG SPOON WHO EATS WITH THE DEVIL"

In precision weighing, the operator stands at a distance to avoid the effect of heat of the body. Note four long operating rods. The scale is read by means of a small telescope

Now you and I, sir, as scientific men, should be perfectly willing to abandon an old theory if we see any reason to do so, and we have actually done this many times. Our retention of the classical mechanics is not due to conservatism, but to the fact that the experimental evidence on which it is based is still perfectly good. Thus the new theory of the equivalence of mass and energy, for the lack of a ticket of its own, rides into acceptance on the lap of the older doctrine, which refuses to part with its child, and will, in fact, rather get off the train.

On this basis you will see that the doctrine of the mass equivalent of energy is independent of the theory of relativity. If the theory of relativity supports this doctrine, so much the better for relativity; it gains strength rather than imparts it.

But it may now suggest itself to you that I have told but half the story. I have mentioned various instances where bodies have lost mass because they have lost energy. What about bodies that gain energy? Does their mass increase?

YES, we must go the whole logical way. If energy in leaving carries away a little mass, then energy in returning must bring it back. If cold water weighs less than hot water, then hot water must weigh more than cold. If the water resulting from the combination of oxygen and hydrogen weighs less than its component gases, these gases must weigh more than the water formed from them. The merest child who is old enough to set a kettle of water on the stove may be said to have created a little mass; and the decomposition of water by an electric current involves a similar increase of it.

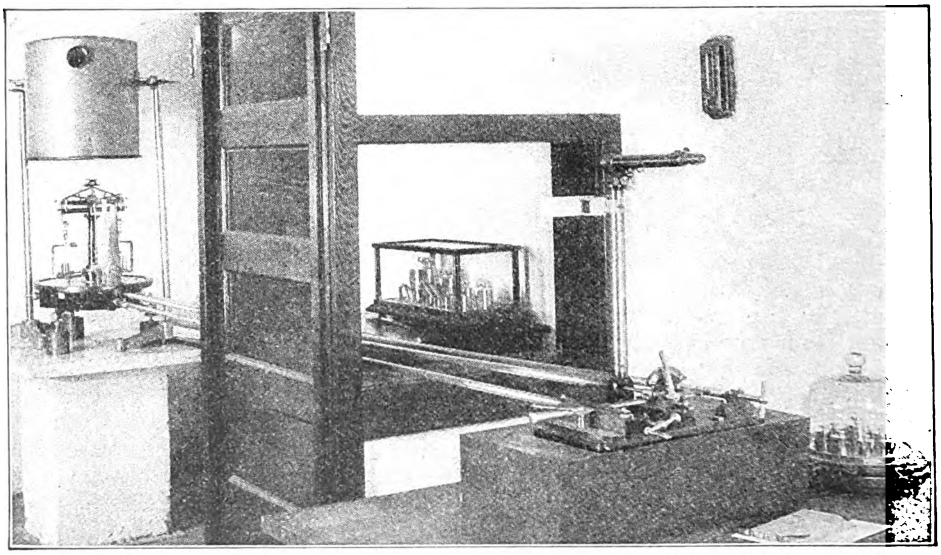
Another curious aspect of this principle is found in the case of lifted weights, which according to the older mechanics, possessed increased potential energy by virtue of the work that had been done upon them. We say now that the lifted weight is a little more massive. The rather vague concept of potential energy has become a definite, weighable quantity.

I can appreciate, sir, to the full the wrench that the effort to accept such a doctrine must give your feelings; but let me now apply to your hurts a salve that I have found beneficial in my own case. The old doctrine of the conservation of matter is no longer to be accepted as strictly true. Small as are, the departures from it in our present experience, if continued long enough they may become very large. In a million million years the mass of the Sun will be but a fraction of its present amount. The old doctrine is gone, but a new and more general one stands ready to take its place. Matter disappears as such, only to reappear as energy. There is neither creation nor annihilation, merely a change of form, such as we have long been familiar with in the principle of the conservation of energy.

In place of the older principles of the conservation of matter and of energy we have a new and more inclusive principle of the conservation of what we may call "matter-energy." Two concepts have been replaced by one; matter and energy are henceforth to be regarded as particular aspects or special cases of this new and broader concept for which we lack as yet a suitable name.

The unification of our ideas about Nature goes on apace. This reduction of two mysteries to one is but another step in a process with which you, as a student of physics, are doubtless familiar. All through the 19th Century and into the 20th, we find this process repeated many times. At the beginning of the last century visible light, radiant heat, and the invisible photographic rays were regarded as separate entities. Now the three are one, and to them have been added at one end of the spectrum the long waves of radio communication and at the other the X rays and the cosmic rays. Maxwell correlated the two concepts of light and electricity; Ohm and Faraday those of electricity and magnetism. And finally, in the 20th Century, Einstein, in addition to correlating gravitation and inertia, showed that matter and energy are but two different sides of the shield.

THE trend of the times is unmistakable. We must go along or be left behind. And I hope, sir, that this little effort of mine may enable you to keep us company with a clear conscience.

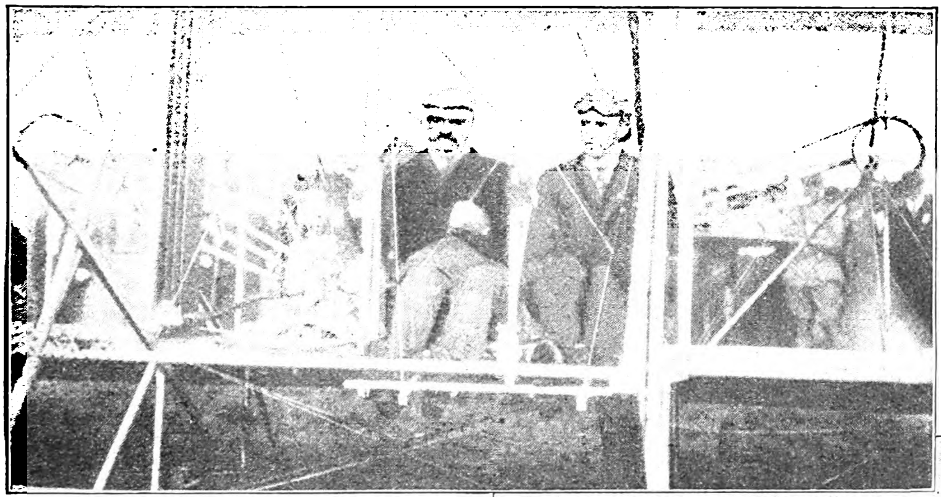


A DELICATE VACUUM BALANCE AT THE BUREAU OF STANDARDS

The cap is raised to show the balance. When lowered, it forms an air-tight joint at the bottom, permitting the air to be exhausted from the balance. All manipulation is by rods

"Firsts" in Aviation

As we look back through 25 years and more of aircraft development, we find along the way certain highlights which serve to indicate the progress of the art. The first and only president of the United States to fly; the first and only woman ever to test an airplane for the government; the first dual control to be installed in an airplane; the first government dirigible; the first time a battleship acted as mother craft to an airplane; these are the subjects which we illustrate on this page. The photographs are from the files of Elizabeth H. Gregory, reporter and feature writer.

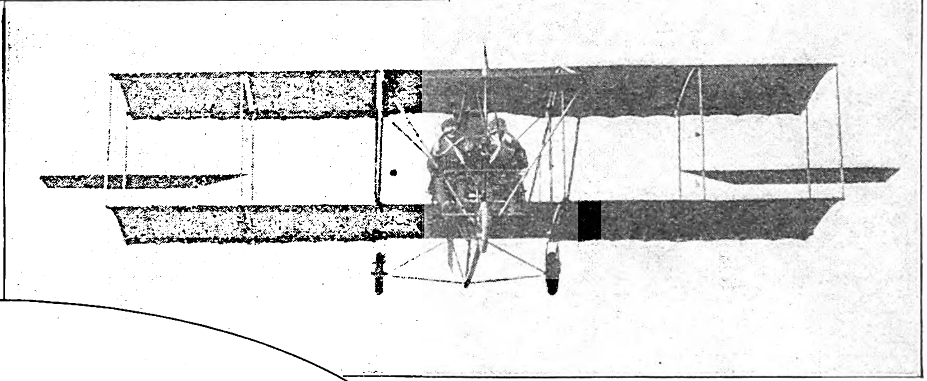


▲ "TEDDY" FLEW

Recently a controversy arose as to whether the president of the United States should fly if he so desired, and statements were made that never in the history of aviation had a president gone aloft. Here, however, is pictorial evidence that one president, at least, has braved the upper air. In 1910, the late president, left, flew as a passenger with Hoxie in a Wright biplane

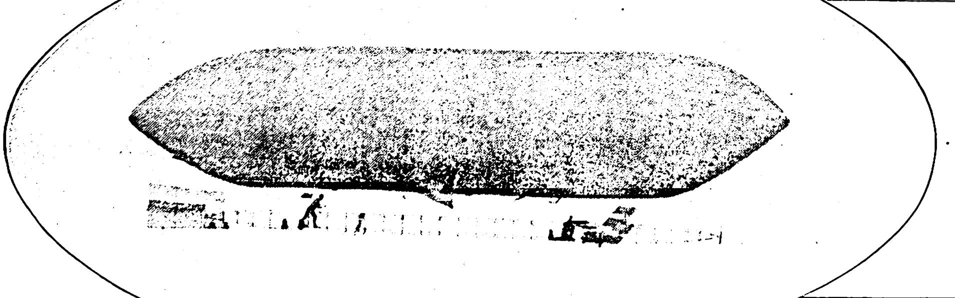
▲ BERNETTA MILLER

Miss Miller was the only woman to make a test flight for Uncle Sam. In 1913 she piloted a Moisant monoplane



▲ FIRST DUAL CONTROL

In the early days of flying, students were told all about it on the ground, given a few flights and then told to "go to it." They first guided the ship around the field on the ground, and then took short "hops," gradually increasing the height. In 1911, Glenn H. Curtiss installed the first dual control; instruction methods changed

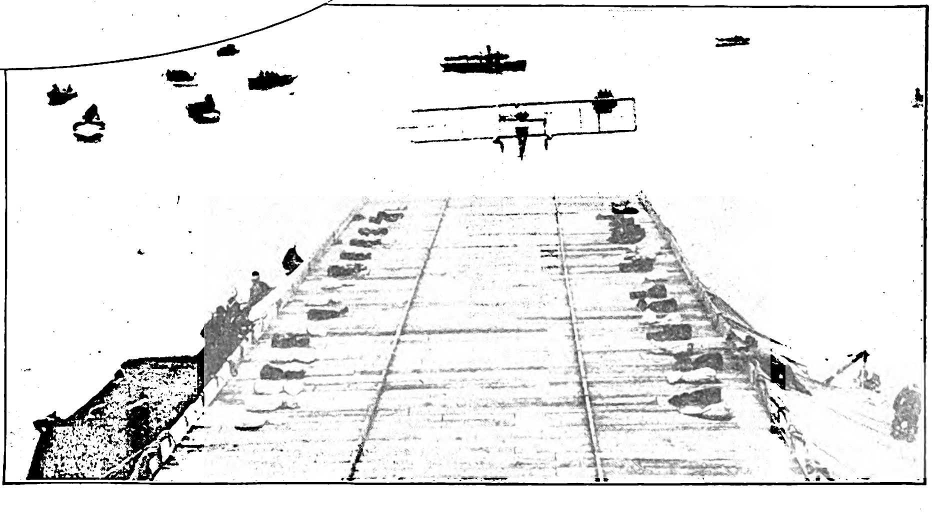


DIRIGIBLE NO. 1 ▲

In August, 1908, Captain Thomas S. Baldwin delivered this 120 foot dirigible balloon, the first one ever ordered, to the United States Government. It was named *Dirigible Balloon Number 1*, and carried one passenger and pilot. It was designed for scouting purposes

BATTLESHIP PLANE ➤

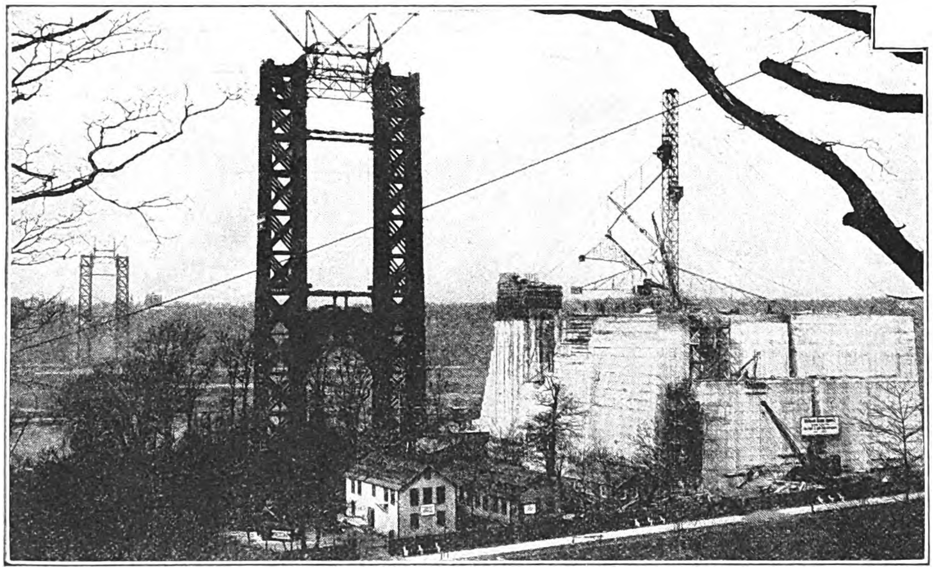
Some of the present-day feats with up-to-date planes may not seem so thrilling when we consider that, in 1911, with a crude machine, Eugene Ely landed on the deck of a battleship and later took off from the same place



Work Progresses On Mightiest Bridge

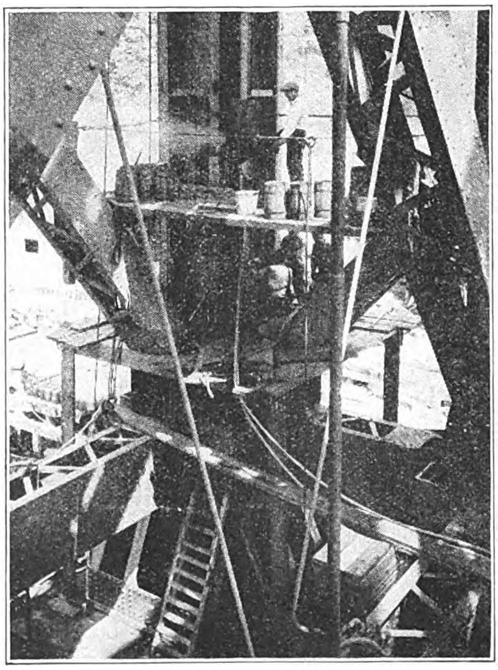
Hudson River Span Is Scheduled for Completion in 1932. The Towers are Rising Rapidly

STANDING prominently out against a background of apartment houses on the east, against the Palisades on the west, and against a majestic sweep of river, north and south, two massive steel towers are nearing completion in the Hudson River opposite uptown New York City. These towers, which are higher than the Washington Monument, are to support the world's greatest bridge, a bridge that is to solve, to a great extent, the problem of traffic movement between New York and New Jersey. Consequently, it will provide quicker access to Manhattan for countless thousands of motorists.



TOWERS AND NEW YORK ANCHORAGE IN FEBRUARY, 1929

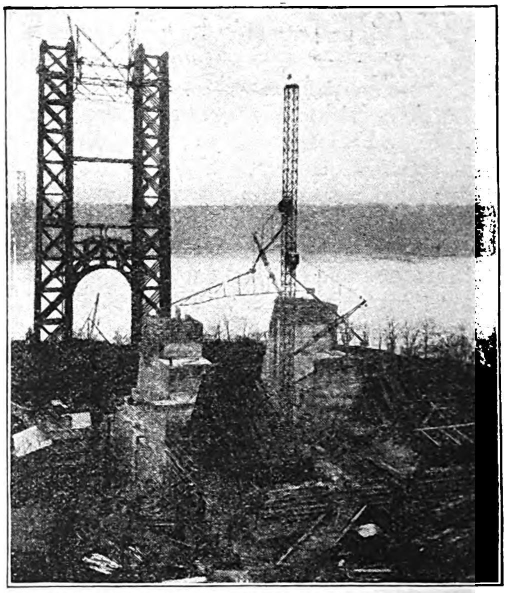
This concrete block, which is to be faced with granite, is the largest of its kind in the world; compare with contractor's two-story frame house. Riverside Drive is in the foreground



800,000 FIELD-DRIVEN RIVETS

About that number are in the two towers. Here a splice in a tower is being riveted

Besides the towers, each of which will carry at the top a cable load of 112,500 tons and which are later to be encased in concrete and granite masonry, other works, less visible to the distant or casual observer, are proceeding rapidly. The massive concrete and steel anchorage on the Manhattan side was completed in March, three months ahead of specified time. The extensive tunnel operations necessary at Fort Lee for the New Jersey anchorage, are likewise finished. During the past winter the excavating for the New Jersey approach was virtually completed, elevators were installed in the towers, preparations were made for erecting the cables—scheduled to be begun during the coming summer—and other incidental details were taken care of. The tower elevators are for the use of the erectors at present but when the bridge is completed, new cages will be installed so that the elevators may be used by the sight-seeing public.



STEEL IN NEW YORK ANCHORAGE

The wire cables will be attached to the steel shown, which was later imbedded in concrete

By the end of 1927, the two large cofferdams for the New Jersey tower foundation had been completed and the placing of concrete within them started. Upon removal of the overburden of earth, the rock was found to be, throughout, of solid sandstone of varying degrees of hardness and of very rugged surface. This was fortunate because the natural steps formed an excellent bond with the concrete so that little blasting was necessary. The concreting proceeded rapidly. About nine feet below water level, the granite facing was begun and thereafter kept pace with the concreting. This foundation work involved 75,500 cubic yards of dredging, and placing of 35,480 cubic yards of concrete, 1400 cubic yards of granite, and 300 tons of reinforcing steel.

THE New York tower rests upon a rocky point and consists of two piers or bases, one under each leg of the tower. Each base extends slightly beyond the water line so that only shallow, simple cofferdams were necessary to exclude the water. Only 7300 cubic yards of rock excavation and placing of 9700 cubic yards of concrete were involved here.

The roadway on the upper floor of the bridge will intersect the rock face of the Palisades about 50 feet below their summit and the lower floor will be about 35 feet below this level. Thus the New Jersey highway approach consists of an open cut through the Palisades for a distance of 750 feet. When completed, it will be 146 feet wide at the roadway and will have involved the removal of 220,000 cubic yards of rock.

The New Jersey anchorage tunnels, which are of such size that they could accommodate four trolley tracks on each of two levels, are below the lower level and at the end of inclined shafts. In these tunnels, the 61 strands of each of the cables will be spread out, finger-like, and fastened to eyebars connecting to anchorage girders set in concrete. Eyebars, chains, girders, and concrete will completely fill the tunnels.

Perhaps the most interesting part of the work thus far is the construction of the massive concrete block which will serve for anchoring the cables on the New York side. Since each cable is to be made up of 26,474 double-galvanized, high strength, steel wires, each .192 of an inch in diameter—making a total diameter for the cable of about 36 inches—the weight of the cable alone would make a huge anchorage necessary. Add to this, however, the weight of the bridge structure, the estimated traffic load, and a large safety factor and it will be seen that only a miniature mountain of concrete would suffice as an anchorage.

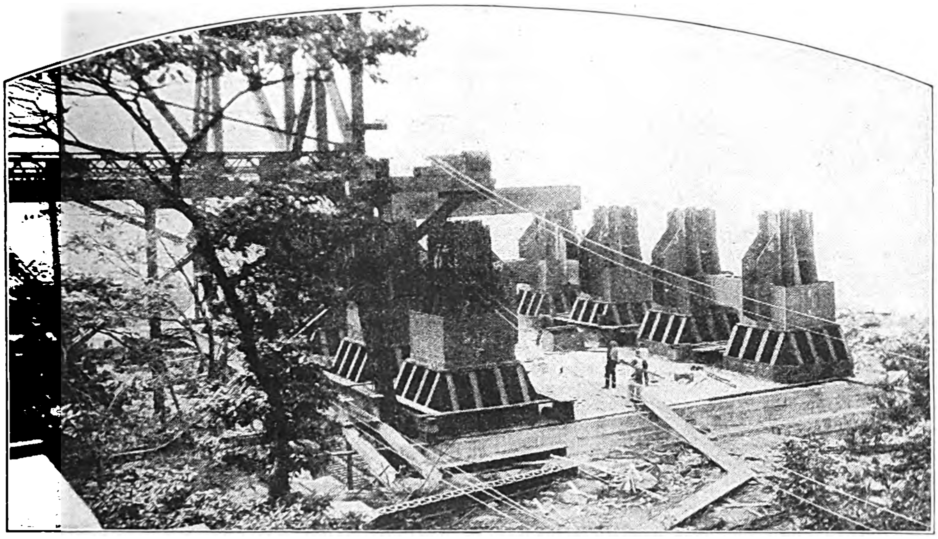
The concreting of this anchorage constitutes completion of only the first stage of the work. Later, certain concrete backing which was omitted, and all granite facing, will be constructed. The anchorage will represent, when fully completed, a gigantic masonry block about 200 feet wide, 290 feet long at its base, and 130 feet high, resting on solid bedrock.

Construction of an extensive dock on the river shore south of the New York tower was necessary for unloading sand, gravel, and cement. Two belt conveyors carried materials a distance of 850 feet to the mixer plant. Two one-yard concrete mixers discharged into a hopper which controlled the flow to a high speed conveyor belt. This belt carried the mixed concrete to another hopper at the base of the concreting tower which was 265 feet high. From this tower, concrete was distributed by means of a counterweight chute capable of movement over a wide area.

Twenty heavy girders and 976 eyebars were imbedded in the concrete after having been given three heavy coats of red lead paint. This first stage of the anchorage work involved the excavation of 16,000 cubic yards of rock, the pouring of about 110,000 cubic yards of concrete, and the setting of about 2500 tons of steel reinforcement and cable tie work.

It is a far cry from the day, a little over a hundred years ago, when Thomas Telford finished, in Wales, what was then the world's greatest suspension bridge which had a 503-foot span. The Hudson River bridge with its 3500-foot span will eclipse not only this famous structure but also all succeeding ones by a large margin. And while the new monster bridge is not likely to be ranked throughout the ages as the eighth wonder of the world, as was predicted for Telford's, it will surely stand as the world's greatest bridge for many years to come.

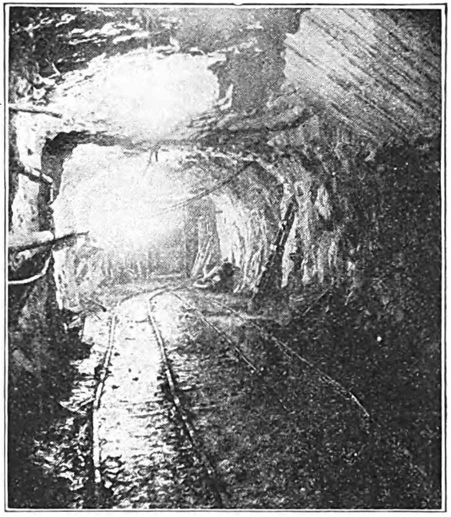
¶ *A 600 or 800-mile pipe line for carrying oil? Impossible, you say? Not at all. They're economically practicable projects, as oil producers have learned by experience. An article on the subject is coming in an early issue.*



All photographs courtesy Port of New York Authority

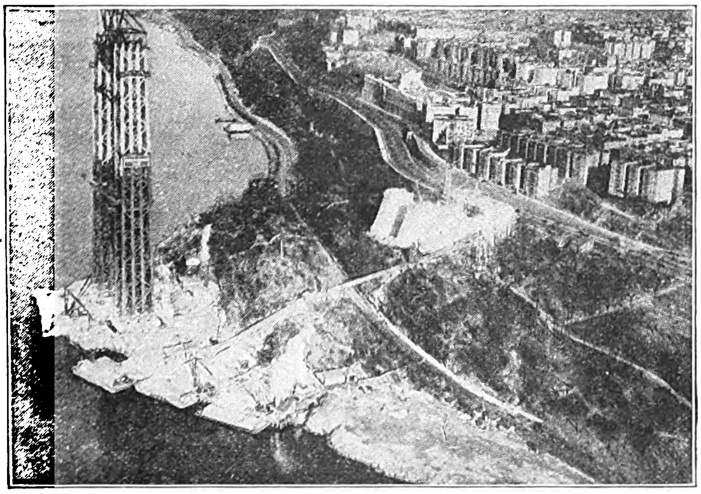
COLUMN BASES OF A TOWER LEG IN PLACE

Each of the two legs of each tower contains eight columns. In this photograph of the New York tower, the relative size of their bases may be noted by comparison with the workmen



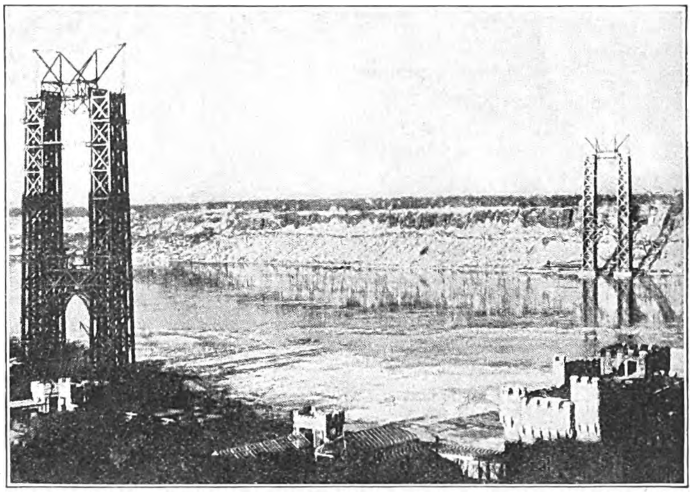
NEW JERSEY ANCHORAGE TUNNEL

One of the tunnels, cut in solid rock, into which cables will extend and be tied



MANHATTAN IN THE BACKGROUND

Anchorage and towers on the New York side. The anchorage stands as a mountain of concrete before the city apartments



THE PALISADES LOOMING CLEAR AND COLD

The two towers as seen from the east. When completed, visitors will be whisked upward in elevators for a splendid view of the city

The Highest Known Velocity

Astrophysicists Have Just Determined that One Universe of Stars Is Moving Through Space at Five Thousand Times the Speed of a Rifle Bullet

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

TWO unusually interesting items of astronomical news have just appeared in the "Communications from the Mount Wilson Observatory." The first, by Mr. Milton Humason, deals with spectroscopic observations of a faint and probably very remote nebula.

On the borders of Aquarius and Pisces there is a cluster of small spiral elongated and globular nebulae. The brightest of them, which is known as N. G. C. 7619 because it bears this number in the "New General Catalog" of nebulae, was observed with the 100-inch telescope and a photographic spectroscope especially designed for the study of very faint objects. The photographed spectrum is only a quarter of an inch or so long, yet so faint is the light that to obtain the two successful plates, exposures of 33 and 45 hours were required; working all night, shutting up the apparatus light tight, and then starting again the next clear night till the long task was completed.

THE resulting spectra resembled roughly that of the Sun—as might be expected if this remote nebula, like many nearer ones, is a huge swarm of stars far too remote to see separately—but the lines in the spectrum were at first barely recognizable, for none of them were in the familiar places. Measures showed, however, that they were the familiar solar lines enormously shifted toward the red.

Such a shift would be produced by a rapid recession of the nebula, but when the corresponding velocity was calculated it came out at 3800 kilometers or nearly 2400 miles per second! This is great quite beyond precedent, the largest motion previously known being 1800 kilometers per second —also for a faint nebula and likewise one of recession. The correctness of this remarkable result is checked by the agreement of the two plates within 2 percent, and there can be no doubt of its substantial accuracy. Observations on other faint nebulae are under way, and within a year or two we shall know whether these too are moving at equally great speeds.

Mount Wilson Observatory

THREE INTERESTING SPIRALS

These are N.G.C. 7317, 7318, and 7319, photographed in eight and one half hours with the 60-inch reflector

Along with this noteworthy observation comes an important piece of theoretical discussion by Dr. Hubble, whose pioneer work on the distances of the Andromeda nebula is well known. By similar methods he now gives the distances of 24 nebulae. All but five of them, when photographed with the 100-inch telescope, show the brightest at least of the separate stars of which they are composed, and knowing how bright these appear, the distance can be estimated. Four others belong to the great cluster of nebulae in the constellation Virgo, whose distance can be found on the assumption that the average brightness of the nebulae in it is the same as that of the nearer nebulae previously studied. Finally, one small, bright nebula appears to be in reality as well as in appearance a companion to the Andromeda nebula.

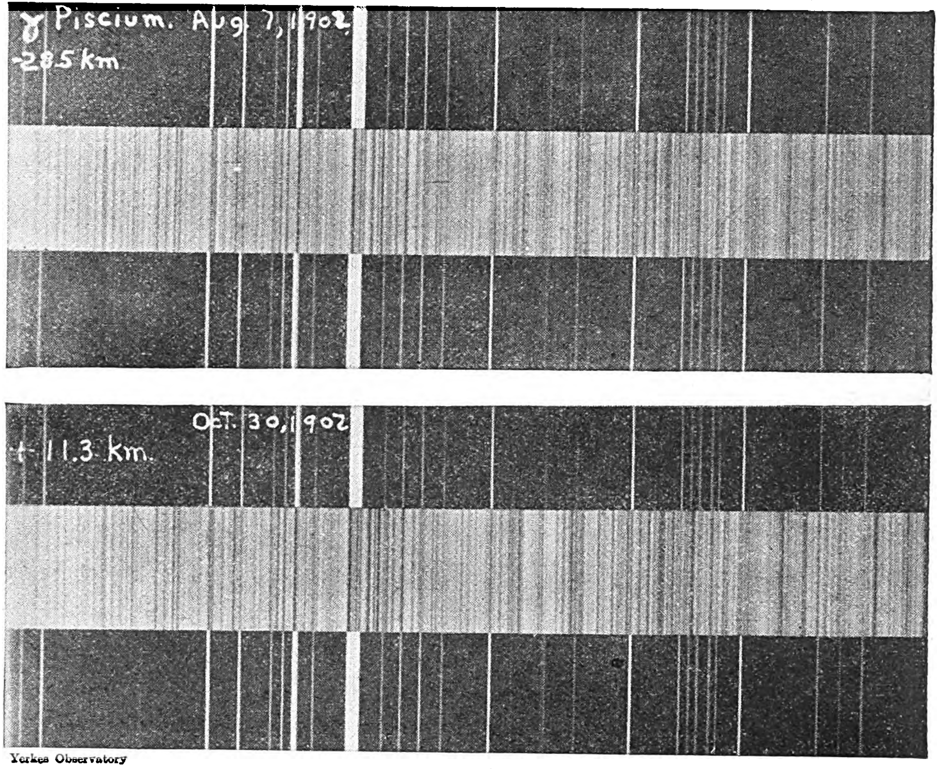
The table of distances which Dr. Hubble gives is at first glance surprising. It is remarkable to see the distance of the large Magellanic Cloud listed as "0.034," and that of the Andromeda nebula as "0.27." Since the nebulae as a whole are so remote, it has been found best to adopt a new unit of measurement which some people call a "megaparsec." This corresponds to a million parsecs, or 3,260,000 light-years, a parsec being 3.26 light-years. Translated with this aid it appears that the Magellanic Cloud is 110,000 light-years off and the Andromeda nebula 840,000. These values are by this time familiar, but the next nearest nebula is at 1,500,000 light-years. Then follow a dozen with distances varying from 1,600,000 to 4,500,000 light-years, while the Virgo cluster appears to be at 6,500,000, which, great as it is, is less than Shapley's estimate of 10,000,000 light-years.

FROM these distances the brightness of each nebula can be found. The variation among them is a hundred fold. The faintest gives out 10,000,000 times the Sun's light and the brightest is a billion times more luminous than the Sun, doubtless by the combined light of hundreds of millions of stars.

These data alone would make the paper noteworthy, but Hubble's main point involves a comparison of the distances of the nebulae with their spectroscopically observed velocities. A mere glance at his table shows that the remotest nebulae have the most rapid motions and (as has long been known) that all of them are receding from us. This suggests that for some reason or other, the speed of a nebula is nearly proportional to its distance.

Before this can be fully tested we must take account of the probability that the Sun is itself in motion. A simple calculation verifies this assumption. It is found that, compared with the general average of the nebulae, the Sun is moving about in the direction in which the bright star Vega appears in the sky and at the rate of 280 kilometers a second. Allowing for this, the remaining motions of the nebulae show a very pronounced "distance-effect," proportional to the distance and amounting to 500 kilometers per second at a million parsecs. The outstanding velocities of the nebulae, after this effect is allowed for, drop to the relatively low average of 150 kilometers per second, which may reasonably be attributed to the random motions of the individual bodies.

This conclusion that the nebulae are receding from the Sun in all directions, at rates proportional to the distances, is so remarkable that confirmation is desirable; and Hubble has such evidence to offer. First, there are 22 other nebulae for which the radial velocities are known, but not the distances (since no stars have been observed in them). Their average distance can, hovever, be computed from the average brightness and comes out 4,500,000 light-years. The average observed velocity of recession is 745 kilometers per second—almost exactly what is predicted by Hubble's formula, which was derived from a quite different set of nebulae.



Yerkes Observatory

HOW MOTION IN THE LINE OF SIGHT SHIFTS THE LINES

This shows effect of the earth's revolution around the Sun: in August the motion with respect to the star Gamma Piscium was greater (more shift to the right) than in October

FROM the observed rates of recession of these nebulae it is then possible to estimate the distances (by ignoring the effects of their random motions). The results range from 2,000,000 to 11,000,000 light-years and should be good on the average to a million light-years or so.

The same method applied to Humason's fast moving nebula gives a distance of 25,000,000 light-years. The distance of the cluster of nebulae to which it belongs can be estimated quite independently from their average brightness (assuming as is reasonable that their real brightness averages the same as that of other nebulae) and comes out 23,000,000 light-years.

The existence of the strange "distance effect" appears therefore to be conclusively proved. If it continues to be proportional to the distance for still remoter nebulae, their spectra would be very strange. A nebula ten times as far away as Humason's could still be easily photographed as an object of the 17th magnitude, and for this we might expect a velocity of nearly 40,000 kilometers per second. This would shift the sodium lines from the yellow part of the spectrum far into the red! The chance of photographing the spectrum of so faint an object with existing instruments appears to be very small, but velocities a good deal higher than have yet been observed should be attainable.

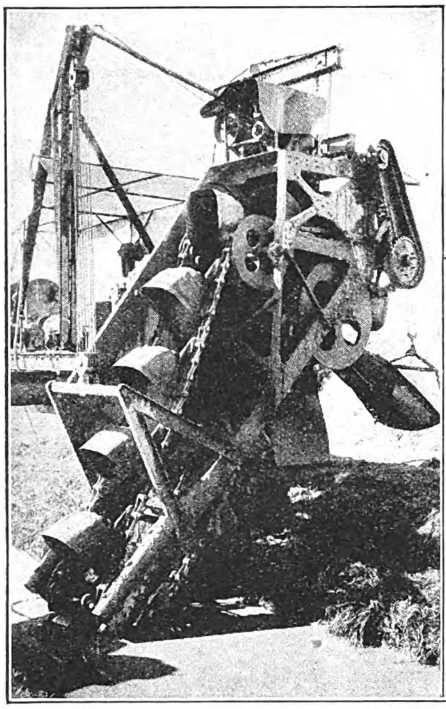
By this time, however, the reader has probably long been asking, "What does this all mean? Are the nebulae really flying out in all directions—away from us and therefore from one another—so that the universe of nebulae is expanding without limits into the depths of space?"

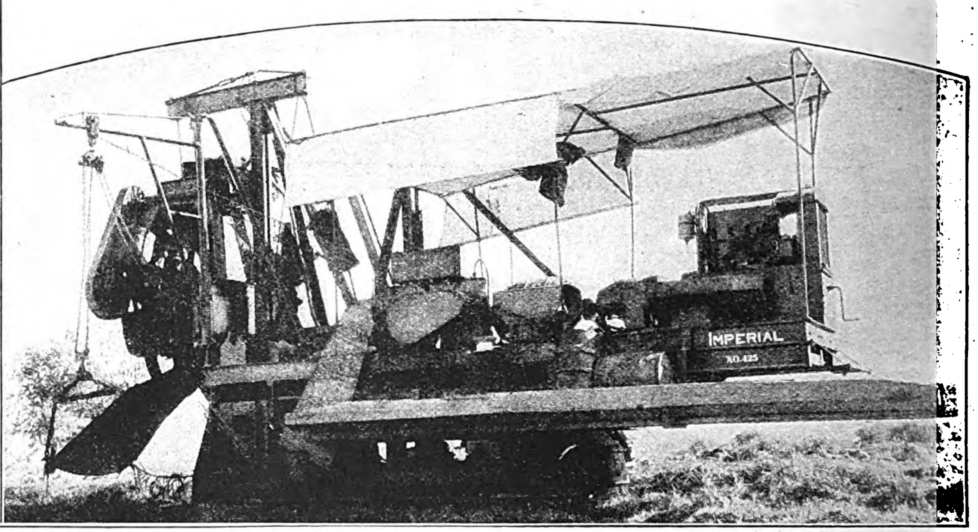
This is a hard problem to solve. The best answer that has yet been suggested comes from a peculiar form of the theory of relativity suggested a few years ago by the great Dutch astronomer de Sitter. This theory, while consistent with Einstein's general ideas, differs from his formulation in detail. Mathematically it is characterized by great elegance; practically, it leads to very strange results. For the remarks which follow, the writer is greatly indebted to a brilliant résumé by Prof. Tolman: In any "small" part of space not more than 10,000 light-years in extent, de Sitter's theory leads to the same results as Einstein's now familiar theories. But in a larger view, space and time have unexpected properties.

ONE difference, in particular, concerns us at this moment. According to the conceptions of Einstein, as well as of Newton, the "nature of things" is such that two material particles at rest in space relative to one another and at a great distance will remain at rest except for the very slow motion due to their mutual gravitation. But from de Sitter's equations it follows that the nature of things is such that any two (or more) particles will automatically start to move away from one another as if they repelled one another with forces increasing with the distance. At such distances as those of the planets from the Sun this effect is negligible and gravitation reigns supreme. But at the distances of the nebulae the reverse is the case. Material bodies like nebulae in a "de Sitter world" will therefore scatter ever more and more widely and recede from one another faster and faster. If originally (that is at the time when we start to think about them) they were fairly close together, they will, after the lapse of ages, be receding from one another with speeds proportional to their distances, just as Hubble's investigations indicate.

IT would be premature, however, to adopt de Sitter's theory without reservation. The notion that all the nebulae were originally close together is philosophically rather unsatisfactory. One asks why, and finds no answer. Meanwhile de Sitter's holds the field. When pushed to the limit it predicts things still more extraordinary than other relativistic theories, culminating in the disappearance of time altogether from the mathematical equations. But this would happen only at a gigantic distance, which from Hubble's data would come out 600 million parsecs or two billion light-years; so that these mathematical curiosities are not of present concern. Indeed they can never be so, for it can be shown from de Sitter's equations that a moving particle or even a ray of light would (in a certain sense) slow up its motion before it reached this critical distance and never quite get there in any finite interval of time. This justifies the picturesque remark of the inventor of the theory, that its more extraordinary consequences "could only happen before the beginning or after the close of eternity!"

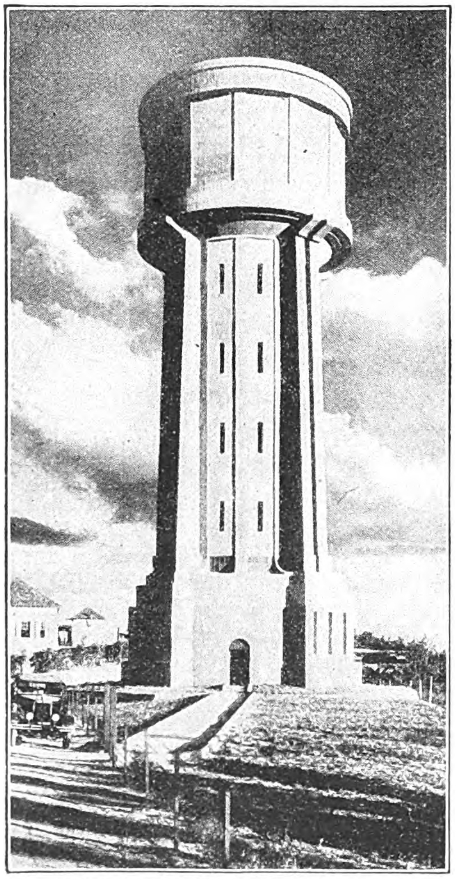
From the Scrap-book of Science





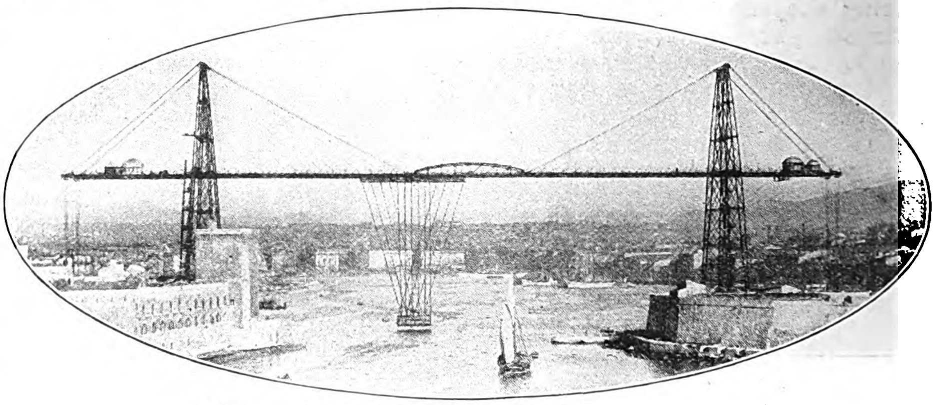
A NEW ENEMY OF SILT AND VEGETATION

The Imperial Valley of California has become one of the most fruitful areas of the country due to its extensive irrigation system. A great deal of silt, however, comes into the canals and ditches from the Colorado River, settles and retards the flow of water, and has to be removed. Above, at the left, is shown the business end of a new dredging machine which has been developed by the Imperial Valley Irrigation District under the direction of W. O. Blair and L. A. Graves. At the right is shown the discharge side. The buckets on an endless chain scoop out silt and scrape vegetation from the banks of the canals as the machine travels on the top of the embankment



COLOSSAL AIR GUIDE TANK

A revolving light on top of this 210-foot water tank recently completed at Nassau in the Bahamas, will serve to guide the air liners of the Pan-American services. An elevator carries visitors to the top platform

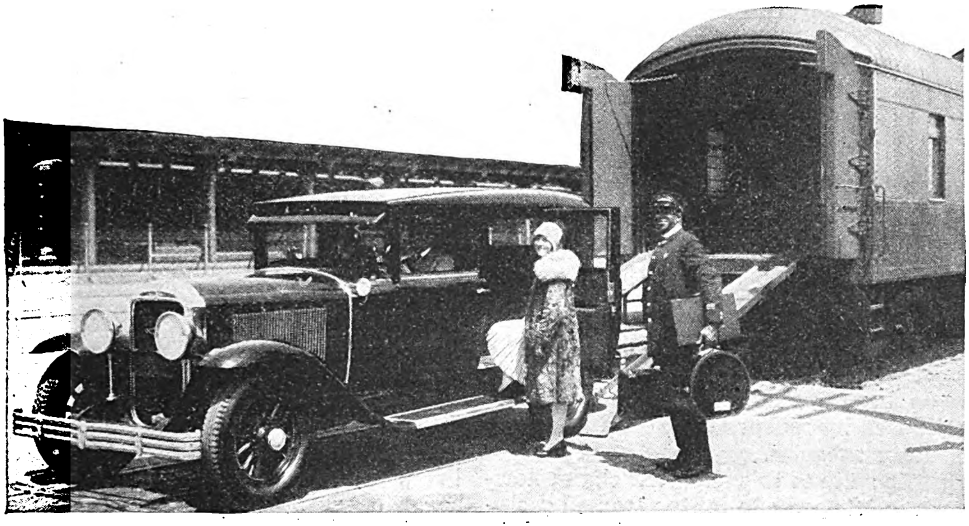


NOT A BRIDGE BUT A HIGH AND DRY FERRY

This structure, while giving the impression of a partly completed bridge, is a crane ferry at Marseilles, France. It is one of three in the world, the other two being at St. Paul, Minnesota, and Rio de Janeiro, Brazil. The passenger and traffic-carrying car moves back and forth suspended near water surface from a track 780 feet long. Note cables necessary for holding down the projecting ends

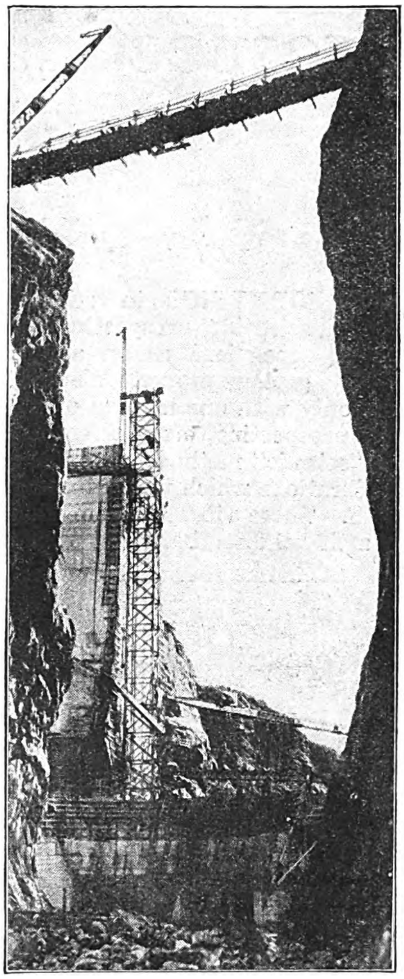
OPTICAL WIZARD OF THE GREEN MOUNTAINS

Russell W. Porter (at left), the Vermont genius who has been called in to help design a great 200-inch telescope for the California Institute of Technology and Mt. Wilson Observatory. Because of his versatility as designer of telescopes and other apparatus, as a mechanic, artist, architect, and composer of music, he has often been compared with the versatile Leonardo da Vinci. With him are amateur telescope makers Hicks and Mergenthaler



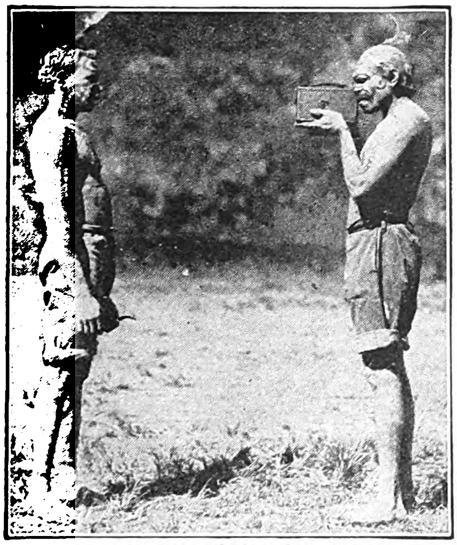
NOW THE FAMILY CAR CAN RIDE TOO

For the motorist who dislikes driving over the rugged mountains between San Francisco and Del Monte, yet who wishes to make the trip and have his car for use at his destination, the Southern Pacific Railroad has adopted this end-entrance automobile car. The automobile is driven up a special runway, is checked like ordinary baggage, shipped, and then unloaded under its own power



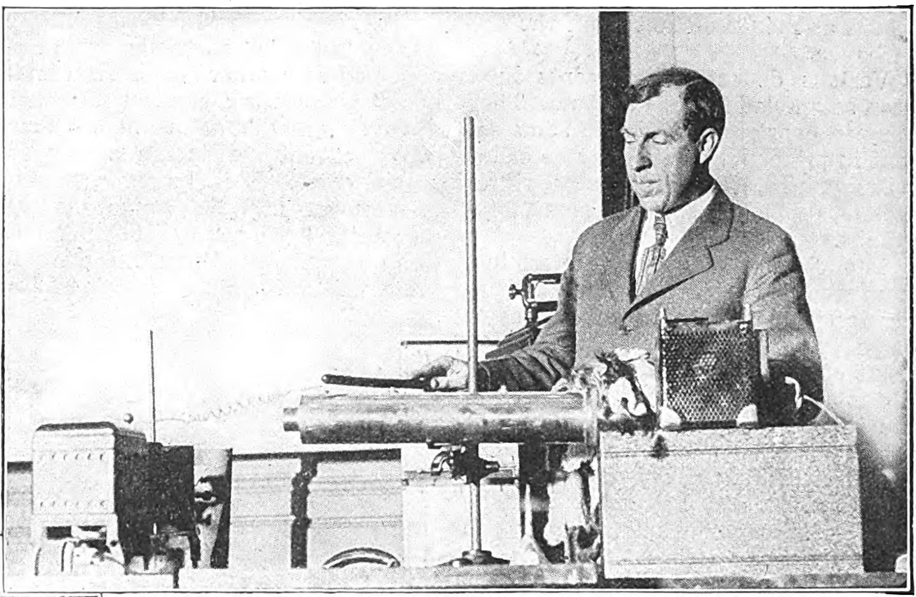
A HIGHER DAM ➤

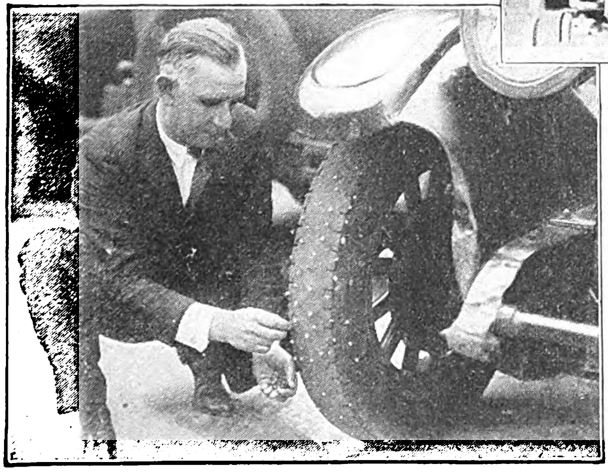
Diablo Dam, 386 feet high—10 feet higher than Pacoima Dam, at present the world's highest—is nearing completion and will soon take its place as the second unit in Seattle's 30,000,000-dollar hydro-electric development on the Skagit River in the Cascades. It will be 150 feet thick at the base and 18 feet at the top; 1195 feet long; and of the constant-angle arch type. It will impound 90,000 acre-feet of water for generating 140,000 horsepower



WATCH FOR THE BIRDIE!

Question: Have we here a new star in the "movie" firmament? No; just a couple of the boys—aborigines of the Palm Islands near North Queensland, Australia, with scarified flesh, painted and top-knotted according to tribal custom, taking a few shots with a new "weapon:" an amateur motion picture camera





◄ A PESKY WEED DID IT

In the west this so-called "puncture weed" is spreading rapidly, especially in the Santa Clara River Valley. The St. Francis Dam flood is said to be the primary cause of this. Last year strenuous efforts were made to eradicate it and if it is not stamped out, farmers as well as motorists will suffer great losses. The weed has spear-like thorns which work farther into a tire with every revolution of the wheel. Any hay containing it is practically valueless

▲ HE MEASURES X RAYS

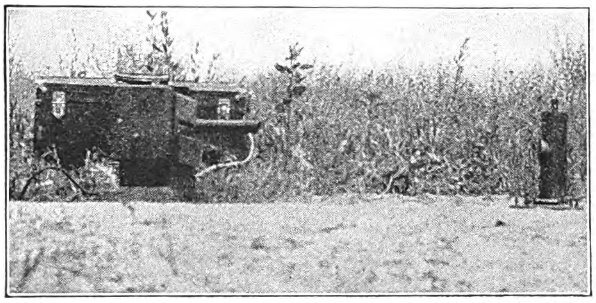
Dr. F. K. Richtmyer, Professor of Physics at Cornell University, demonstrating the measuring of an X-ray beam at a recent meeting of the New York Electrical Society. Dr. Richtmyer is an authority on physiological optics and has done much investigation of the photo-electric effect. During his scientific career, he has been a physicist at the Bureau of Standards, president of The Optical Society of America, and has held other high positions in the field of research

Prospecting with Artificial Earthquakes

How Hidden Mineral-Bearing Formations are Sought by the Seismic Method

By KARL L. KITHIL

GEOPHYSICS in relation to scientific prospecting is now recognized as an adjunct to geology proper. We shall deal here only with one method of geophysical prospecting, often referred to as the "seismic" method. It is the study of vibrations which travel through the earth. These vibrations are produced by artificial disturbances at or near the surface and are measured and determined at points distant from the disturbance.



PORTABLE FIELD INSTRUMENT SET-UP

Figure 1: As the recording is done by optical methods, an opaque tent must be placed over the instruments

Various delicate instruments have been assembled for this purpose. They vary in construction and to some extent in principle. They may be called seismographs, but are really vibrometers, oscillographs, or seismo-vibrographs.

The chief object is to determine, from records obtained by these recording instruments, the idiosyncrasies of earth wave travel between any given point of artificial disturbance to other distant points where such instruments are installed. From a knowledge of these factors some of the structural conditions of the deposits between these points can be deduced. The problem is anything but a simple one and may under certain conditions become too complex to permit any interpretation.

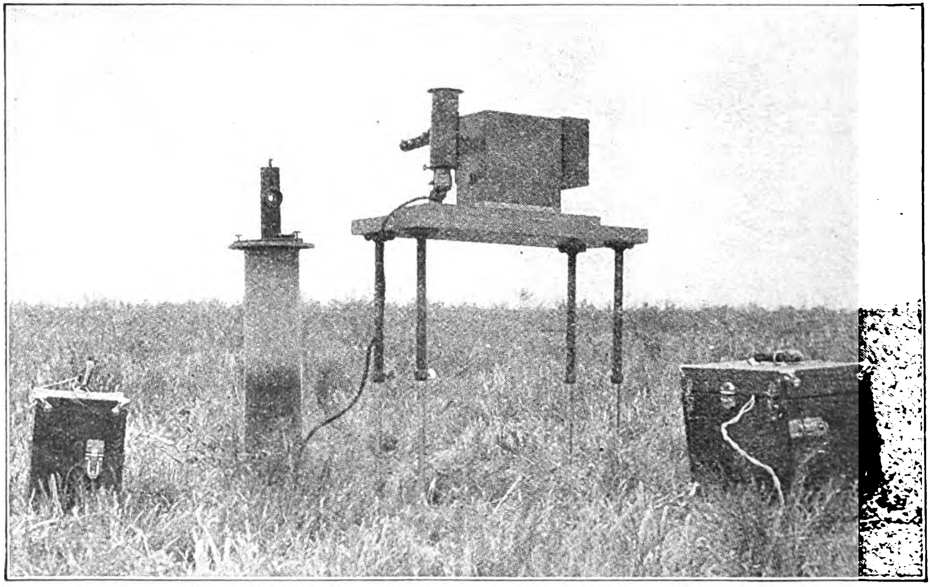
TO expect to obtain results which can disclose the true or even approximate condition of the composition of any portion of the earth requires a most complete knowledge of geology. Geology deals with the structural conditions of our earth. We know that beneath the topsoil of the earth exist many different kinds of rocks of different ages and of different composition, and that they were deposited in the ground under greatly varying circumstances. By natural action these earth masses and existing structures have often been dislocated, rearranged, and broken up, sometimes forming very complex structures. As time went on they have undergone further changes caused by redeposition, eruptions, and other agencies.

In spite of this apparent chaos, however, it is possible for the trained geologist to study these conditions and to piece together the knowledge which is revealed to him by exposures here and fragments there, or by other visible disturbances elsewhere. This latter study, however, is practically limited to what can be observed from the surface or in artificial openings. Geologizing for formations, therefore, whether it be for those likely to be mineralized or for oil and gas, is difficult and often impossible where surface indications are either entirely missing and where the evidences are covered with loose materials.

The "seismic" methods, which are classified with other geophysical methods of prospecting, can not, of course, discover minerals or ore bodies themselves, except perhaps in a very few special cases. It is, however, possible to discover and determine by such means the existence and possible location of formations beneath the surface of the earth which may contain mineral deposits. We can also detect the occurrence of fault zones, folded areas, dike intrusions, thickness of cap rock formations overlying mineral substances, and thickness of alluvial beds overlying bed rock. Their probable location and extent as well as depth below the surface of the ground can in some cases be determined and approximated.

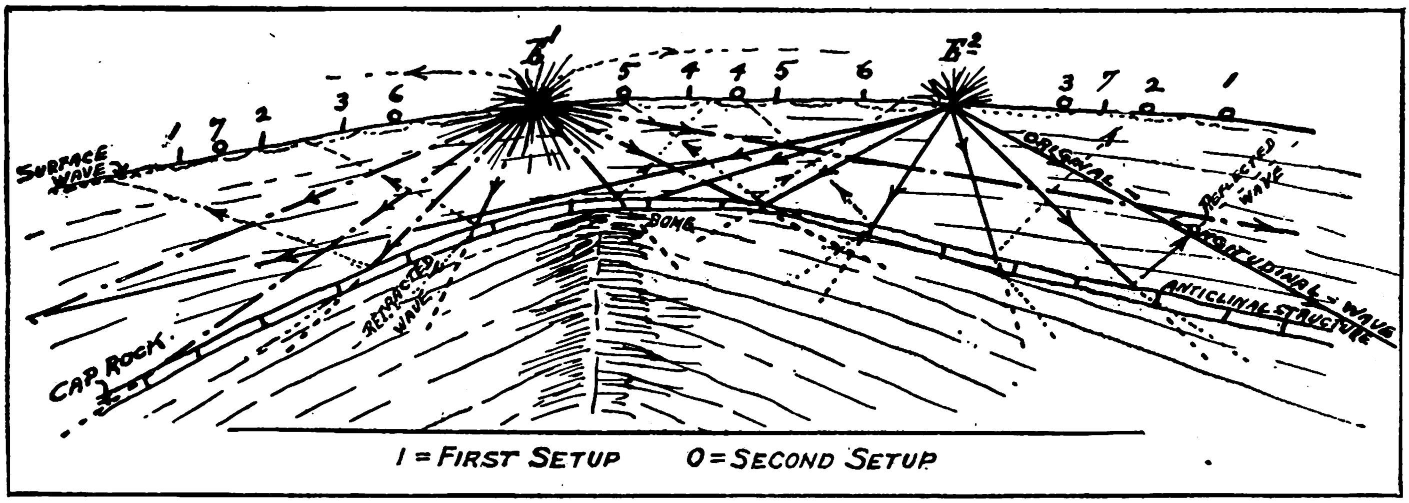
WHILE such information is highly valuable to those interested in the development of the mining and oil industries, it must be understood that so far it has not been possible to tell from such determinations—even if the structural conditions have been accurately defined—whether, for example, the ground so tested contains either gold in alluvium, or minerals within a certain formation, or oil and gas under typical oil and gas structures. The ground which has disclosed these formations or structural conditions through seismic tests must be opened up by digging or drilling, or may be checked up by other geophysical methods.

We now proceed a step further and delve into the theory of the phenomena of wave transmission and wave propagation through solid earth materials. An artificially created earth disturbance results in the propagation of a wave through the surrounding earth materials. The waves, during their propagation through the earth, are



ANOTHER VIEW OF THE SAME INSTRUMENTS

Figure 2: Here the receiving instrument rests on a metal pedestal and sends its beam of light to the photographic recording apparatus placed on a collapsible table. Tent not shown



All sketches by the author

A TYPICAL EXAMPLE OF A SIMPLE PROBLEM IN SEISMIC PROSPECTING

Figure 3: Explosions brought about at different times at E^1 and E^2 send their respective waves or vibrations in all directions. Some are refracted through the cap rock of the dome, others are reflected and caught by instruments placed at various locations

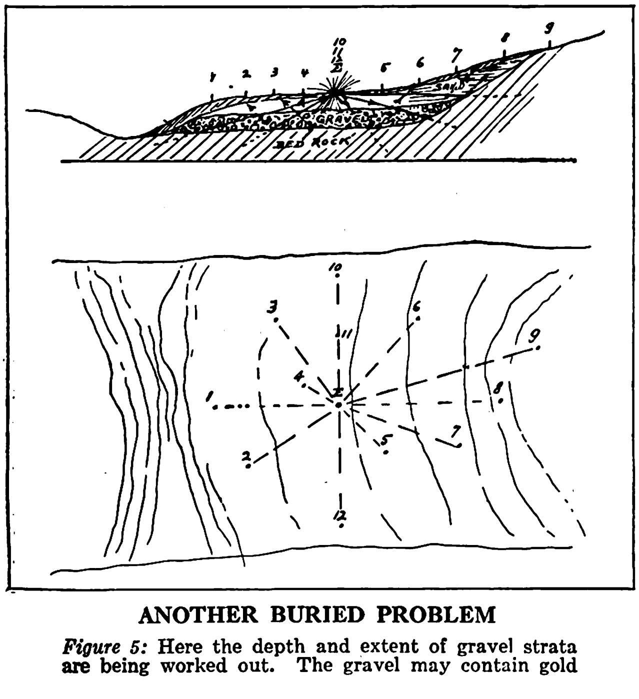
subject to all kinds of hindrances, causing reflection, refraction, diffusion and other changes, when passing from a medium of one kind to another. These influences cause changes in the speed and character of the original waves and their rays as they are propagated through the various kinds of materials and before they arrive again at the surface of the earth at some other point.

Now let us go into the field at an actual place to be tested and where preliminary geological observations have given indications of the possible existence of suitable formations.

We see only the surface material and can only surmise what the ground below may hold in store for us. We also do not know what the conditions are of any of the suspected underlying formations, so far as placement is concerned—whether any changes have been caused in their original position by intrusions or otherwise, or whether these formations have been tilted, folded, or broken up, and whether older or more recent materials are interbedded.

At selected points we place our instruments at predetermined distances from each other. Then we place a charge of dynamite at about the center of the area, or some other suitable point away from the instruments, and get everything in readiness. We next send out a radio wave which through suitable short wave receiving sets starts all instruments simultaneously in operation. After a short time interval we fire the shot of dynamite.

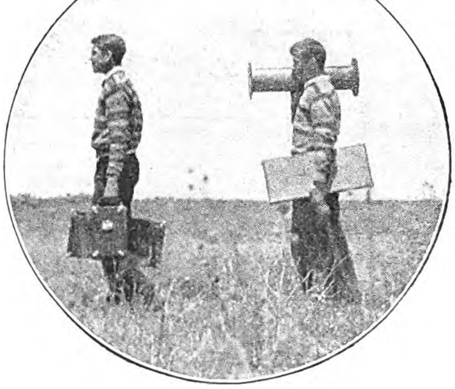
THE entire operation takes only a short period of time and the record is completed. The apparatus should be provided with an automatic cutout, so that the recording device of the individual instruments will come to a standstill after several seconds of time. After that the photographic film or sensitized paper on which the record is automatically made is taken from the instrument and developed, marked and taken back to the office; or else interpretations can be made in the field, especially when the knowledge of the results obtained is of immediate importance and where new readings with a different set-up are required.



ANOTHER BURIED PROBLEM

Figure 5: Here the depth and extent of gravel strata are being worked out. The gravel may contain gold

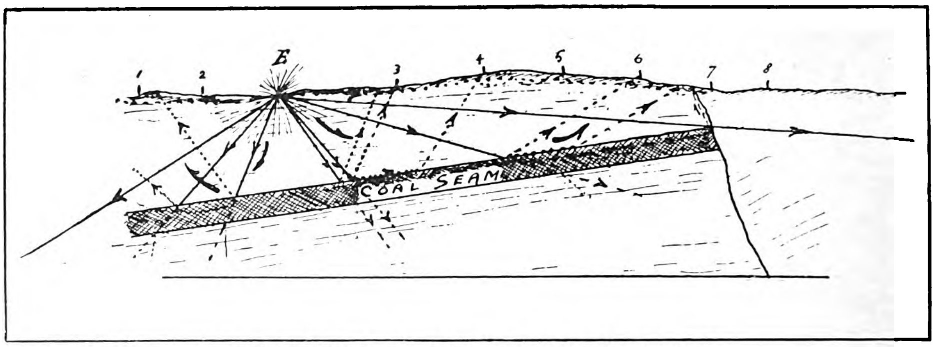
What has happened is as follows: Earth wave travel resulting from the explosion was recorded. The interpretation of the records requires a knowledge of geology, physics, and mathematics. The record shows great complexities in the registration of the lines of configuration, time factors for the arrival of the individual rays, the magnitude of the vibratory movements, their period and, in short, the character of the arriving waves. In fairly homogeneous ground these lines are represented by more or less harmonic movements, whereas in broken up ground or mixed ground these movements become very irregular.



EASILY TRANSPORTED

Figure 4: To facilitate rapid work in the field the apparatus must be light

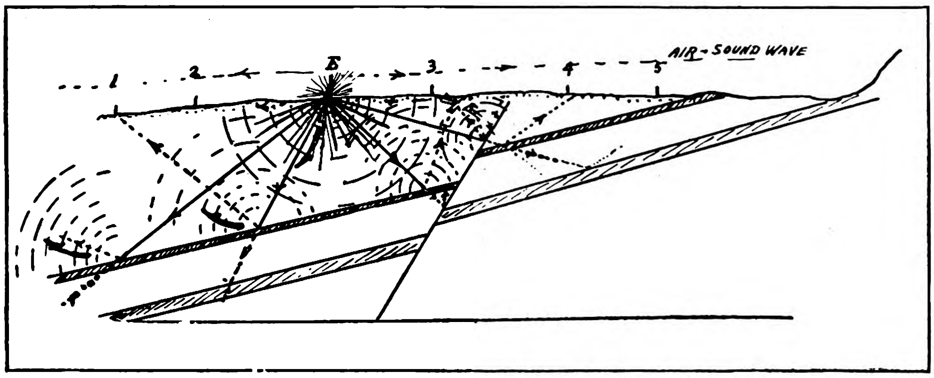
Earth wave travel can be best described as a propagation or forward pushing of vibratory, tremor-like movements within and through earth materials, radiating or expanding in all directions, seeking always, however, the quickest route to return to the surface of the earth. The velocity of wave travel through solids depends upon the density (specific gravity) and elasticity of the various rock or earth materials through which these waves have to pass. As all the different strata constituting the crust are composed of all kinds of materials of different geological ages their composition and consequent physical qualities likewise differ greatly from each other. The various strata differ greatly in moisture content, or the lack of it, which also influences the physical properties of the various rock formations and its individual constituents. These are all very important factors, so that not only density and elasticity but also factors of compressibility or incompressibility, torsional properties, and so on have to be taken into consideration—all of which have some influence on the wave propagation and on the relative movement of the vibratory phenomena.



OUTLINING A HIDDEN SEAM OF COAL

Figure 6: No tangible evidence of coal is in sight, although deduction from geologic evidence indicates its probable existence in the locality. The seismic method then locates the presence, depth, dip, and strike of a suspicious stratum which ends at a fault line

Let us take under consideration an area of ground to be seismologically tested, which from surface conditions appears to be a relatively flat area of land. We suspect that different conditions lie hidden under the soil—conditions which do not conform to the contour of the surface. Take, for example, Figure 3, the surface being covered with soil. Below the deposit of soil is a stratum of material of recent geologic formation, perhaps sandstone and shale. Underlying these is a layer of material of older formation, which may be either flat bedded or showing elevated points or areas protruding into the overlying stratum, forming thereby dome-like structures, anticlines or similar structures; or else showing depressions into the deeper lying rock formations such as synclines. In such cases we can reasonably expect to find by means of the seismo-vibrographic method of measurement the probable depth to the contact of this material. By numerous set-ups of the instruments and repetition of the operation under varying conditions we may obtain enough data from these records to plot out the approximate contour lines and probable depth of this formation.



LOCATION OF BLIND FAULTS BY SEISMIC METHODS

Figure 7: No surface conditions suggest the presence of a blind fault in these strata. Such faults often upset mining plans and increase costs very materially. The seismic method often discovers them and thereby enables the engineers to plan their mining operations

Another example is to determine the thickness and extent of alluvial gravel beds. Figure 5 shows such an alluvial condition. It is covered up with soil to a shallow depth. Below that is 30 feet of alluvial gravel, lying on the bed rock. At points east and west in the lower part of the drawing are indicated the contour lines which show the extent of these alluvial gravels. The depth of such a bed can be determined seismovibrographically.

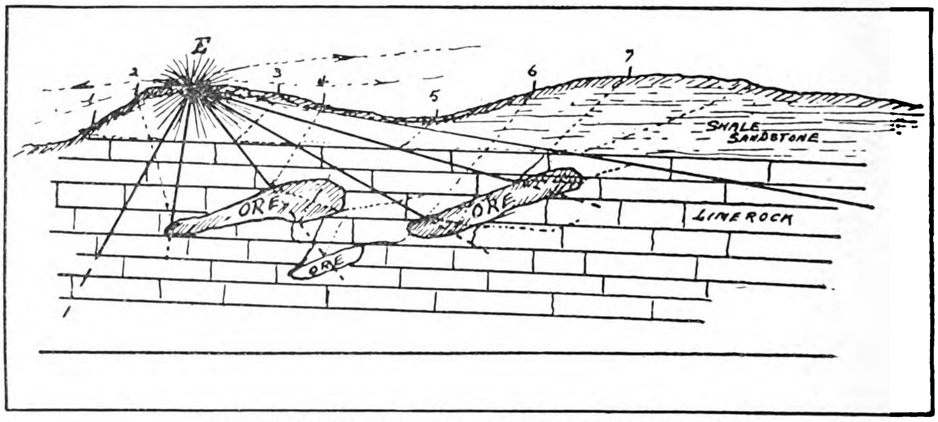
If such beds contain, as is the case in some placer ground, gold and black sands or other minerals in concentrated form associated with the gravel, such a content can not be discovered by such a method, but other geophysical methods, such as magnetometers, may then be applied.

Another form of deposit which is suitable for seismic determination as to probable depth and extent is the coal bed shown in Figure 6. This, as the sketch indicates, is covered up with soil and another rock formation. From other geological observation and deductions previously made, the presence of such occurrence may be expected. The seismic method may reveal the desired data, as to the presence of the formation as well as its extent and depth below the surface. This can then be checked up by means of the electrical conductive methods of geophysical prospecting.

Fault zones covered with surface materials (blind faults) and rock intrusions of varying physical properties may be discovered by seismic methods; for example, see Figure 7.

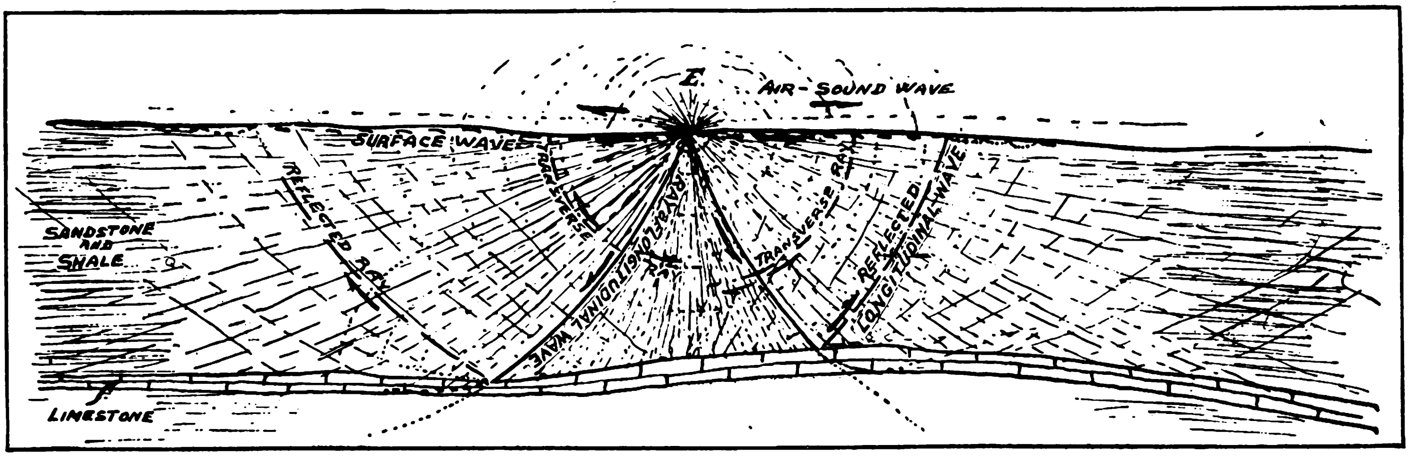
A LARGE body of especially dense material, such as a mineral ore body, imbedded in less dense rock material (Figure 8) but of a more or less homogeneous nature, can also be expected to lend itself to detection by such a method. However, in such a case it cannot be ascertained directly whether the ore body contains iron, lead, zinc, copper, or other minerals. However, the existence of an ore body of greater density and elasticity within a rock formation of considerably lesser density and elasticity should form an excellent target for reflected seismic waves, and could be followed up, as in the case of sulfide ore bodies, by some of the electrical geophysical methods.

Oil pools and gas accumulations are found under cover within anticlines (high points of an arched structure) often deeply buried beneath the surface; or such accumulations are found along the flanks or on top of salt domes. If the conditions are such that this cover overlying the oil or gas pools is of a material having a different density and elasticity than the other masses or



PERCUSSING THE EARTH WITH DYNAMITE

Figure 8: By thumping or percussing the body the physician locates the various organs and any existing growths. Exactly the same principle is employed to find some ore bodies



A GENERALIZED PROBLEM IN SEISMIC WAVE TRAVEL

Figure 9: The source of the disturbance is a charge of dynamite set off at *E*. Sound waves reach apparatus set up at various points, through the air. Radio waves travel faster, however, and are preferable for recording the exact instant of explosion

strata, then the presence of such a condition can be revealed by the seismic method. However, the method cannot reveal whether oil or gas exists in the structure, even if the formation favorable for such an accumulation has been determined.

BRIEFLY stated, we may detect by the seismic method, formations which may turn out to be mineralized, their relative position in the ground, and some of the irregularities in their outline. From interpretable records so obtained, it is possible to learn something of value, which may decide whether further prospecting by other known means of geophysics should be undertaken. This will, to some extent, prevent the expenditure of large amounts of money which are being wasted for wild-catting and fruitless prospecting in unknown ground. This method, in conjunction with other geophysical methods, may help to discover some of the mineral resources the existence of which would never become known to us without such means.

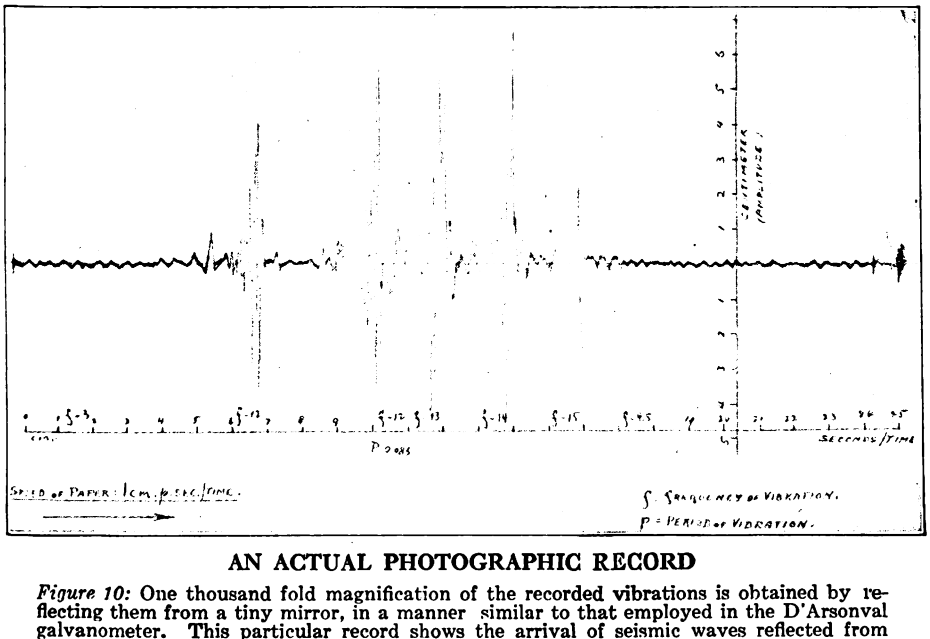
With the development in the field of radio it is possible to employ on each of the recording instruments, a system of radio relays connected with individual receiving sets. These will set all apparatus in operation simultaneously and thus, correct time factors can be obtained. The determination of the differences in time between the recording of the moment of the disturbance and the arrival of all of the successively arriving impressions of wave impulses is of course of great importance.

The records obtained by such means should be taken photographically and preferably by optical means, which permits large magnification of the very minute configurations of the vibratory movements. The records must show the required time intervals in at least one tenth of a second of time; and the speed of the recording paper or film should be high enough to record even relatively high frequencies and take large amplitudes of the recording beam.

The probable effect of a blast of dynamite at the surface of the earth is illustrated in Figure 9. Earth waves are slightly curved rays which are transmitted and propagated in all directions through earth material. A sound and air wave are also created as a result of the explosion, and this is transmitted through the air in all directions. The effect of these latter waves which arrive simultaneously is also recorded on the field instruments. They can easily be recognized, however, by their slower speed and by their different characteristics recorded on the photo-diagram. All these various waves such as longitudinal, transverse, surface, and air-sound waves have different speeds in the order mentioned, the air-sound wave being the slowest.

THE description presented above shows only the simplest form of application. Nothing can be said as yet regarding the possible outcome of such an application in mountainous regions where the greatest heterogeneity of earth materials is known to exist. The greatest accuracy is necessary, whatever method of geophysics is employed or whatever instruments are used for the purpose. The closest cooperation between the geologist, the physicist, and the mathematician is required. So far it has proved possible to determine seismographically only the simplest type of geological structures or formations. As years are added to the experience of the workers, more skill may logically be anticipated.

Finally, a word of caution: The seismic method must not be confused with the so-called "doodle bugs," which depend upon imaginary personal influences or idiosyncrasies of the individual operator. The newer geophysical methods are entirely instrumental and are free from any alleged personal influence or the imagination of the operator. The entire procedure is highly fascinating and interesting and may eventually become of great importance.



AN ACTUAL PHOTOGRAPHIC RECORD

Figure 10: One thousand fold magnification of the recorded vibrations is obtained by reflecting them from a tiny mirror, in a manner similar to that employed in the D'Arsonval galvanometer. This particular record shows the arrival of seismic waves reflected from five underground surfaces. These records are timed (note horizontal scale) while their amplitude is measured on the vertical scale. From this it is possible to calculate the depth and other positional characteristics of the respective reflecting surfaces, and plot the stratigraphical conditions, if they are not too complicated, lying hidden below the surface

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Ultra-violet Rays

AMONG recent investigations of the use of ultra-violet rays is a series of studies made in the Children's Hospital of Western Reserve University School of Medicine. An attempt was made to find the approximate minimal dose of ultra-violet rays as produced by the quartz lamp, which, with exposures given once weekly, would cure rickets. White and colored children were given exposures to the quartz lamp and the extent of the rays was measured by the response of the skin.

Regular pictures were taken with the X-ray machine to find out how much the bones were reacting to the dosage. All of these infants were receiving diets of orange juice, milk, skim milk, and lactic acid, with enough sugar to meet the requirement for energy according to age. It was found that exposure of the infant by placing it, while naked, on the stomach or back for one period each week would cure rickets.

The quartz lamp was placed at a distance of 32 inches for ten minutes, that being a sufficient dosage. In white children with tender skins there is decided redness following such exposure, but not inflammation to the point of peeling of the skin. In case the reaction of the skin is too severe, the dose may be reduced to one half the amount mentioned.

Punch Drunk

AFTER a prize-fighter has had a terrific pounding in the prize ring he may suddenly find himself dizzy and unable to move his legs—or "out on his feet." Dr. Harrison S. Martland accepts the name "punch drunk" for this condition which the fighters themselves call "cuckoo," "goofy," "cutting paper dolls," or "slug nutty." The condition usually occurs to fighters of the slugging type who are poor boxers and who get a lot of head punishment while trying to put over a knockout blow.

One or two hours after the fight the boxer recovers from a hard punch to the head or jaw. If he has been "punch drunk," he may notice later a flopping of one foot or leg in walking, and sometimes mental confusion lasting several days.

Doctor Martland has shown that the condition called "punch drunk" results from a brain injury in the form of multiple small hemorrhages. In the late stages, the condition resembles the "shaking palsy," or Parkinson's disease. Microscopic studies of the brains of persons who have developed this condition show the little spots of bleeding deep in the brain. The records of 23 fighters who have been "punch drunk" show that the physical changes are permanent and may lead to mental defects requiring final incarceration in some asylum.

Pranks With Compressed Air

AT least several times each year deaths are reported of workers in industry who have been subjected to practical jokes or "horse-play" by other workers. In many plants today compressed air is used regularly for many purposes. This is particularly the case in steel welding and in building construction. In some plants air at a pressure of one hundred pounds to the square inch is used in automatic riveting. Recently in an English shipyard a boy aged 14 was killed by a blast of compressed air which entered his bowels when some workers put the hose next to his body as a joke. His intestines were blown to pieces and portions of the boy's clothing were found within the body. In the English case the men who had pointed the hose at the boy were held for manslaughter and committed to trial. The human body is not built to withstand a pressure of one hundred pounds to the square inch.

Changes in Posture

THE health of the growing child is determined by its heredity, its nutrition, infections, and its posture. By our inheritance we have a certain body form which is like that of previous members of our families. Some persons have long, thin muscles; others short, fat muscles. Some people are big boned; others small boned. In the human being, as emphasized by Drs. Sweet, Watson, and Stafford, the middle zone seems to be the place for greatest happiness. People who are too tall or too short find that the world is not accommodated to their convenience. If certain groups of muscles are too strong, the body is tilted into abnormal positions. If nutrition is bad, tissues fail to develop properly; infections may paralyze nerves to such an extent that muscles are unable to act or become weakened and again the body assumes strange positions.

In their consideration of changes of posture during life, the California investigators point out that every child is bow-legged to begin with, becomes progressively knock-kneed, this condition reaching its height at three years of age and receding rapidly in the normal child during the following two years. Formerly physicians were much concerned about this deformity, but nowadays they merely determine that knock-knees is not an inherited family characteristic, and see to it that the child does not wear shoes that are too short or too rigid and which will tend to prolong the condition unduly. Shoes that are too short force the feet into a position which encourages knock-knees. Rigid soles on the shoes of young children prevent development of the foot muscles.

A bed that sags in the center emphasizes the forward droop of the shoulders, especially if a pillow is used. People who sleep on one side in a bed that sags in the center tend to develop a spine that swings sidewise.

As exercises for a child of three years which will aid him in developing proper posture, the authors recommend the following: While lying on the back, the legs, widely separated, should be raised and lowered; while lying on the stomach, the head should be lifted backward and lowered. During the latter exercise the hands may be held over the middle of the back to emphasize the lifting of the shoulder girdle.

Yellow Fever Transmission

WITHIN a year three well known investigators sacrificed their lives to the investigation of yellow fever on the Gold Coast of Africa. The list includes Adrian Stokes, William A. Young and the famous Hideyo Noguchi. Apparently the yellow fever in that territory is more uncontrollable than almost anywhere else in the world. Few people realize the difference between the present era when only a few plague spots of this disease remain to trouble civilization and the time one hundred years ago when yellow fever was a constant menace.

The work of Dr. H. R. Carter and leaders of the Reed commission in Havana and of Surgeon General Gorgas served to eliminate the disease from most civilized sections. However, the campaign goes on. Dr. Johannes H. Bauer's recent report from Lagos, Nigeria, West Africa, indicates that certain forms of African mosquitoes related to the *stegomyia* may transmit yellow fever. He recognizes that H. R. Carter many years ago expressed the opinion that following the analogy of malaria and some other insect-borne infections, these other varieties of mosquitoes would be found associated with the African transmission of yellow fever.

The work of the investigators in Africa develops the important fact that the monkey, known as *Macacus rhesus*, can be used for experiments with yellow fever, thus making it no longer necessary to carry on the dangerous human experiments by which the fundamental facts of mosquito transmission were first established.

Doctor Bauer made studies of many varieties of African mosquitoes, and was able to list three definite varieties which transmit the disease.

"Rider's Legs"

BASEBALL players and football players suffer frequently with "charley-horse," which is essentially a stiffening of the limb due to the rupture of muscle fiber which causes a hemorrhage into the tissues and subsequent pain on movement. Apparently an injury of similar character is "rider's legs." This is a strain of the adductor muscles of the thigh brought about by a sudden forceful gripping of the saddle by the rider in an effort to avoid being thrown. The person affected, at once feels severe pain which may be so severe as to prevent further riding. Recovery may be complete in from two to three weeks, but in some cases the healing may require months. It is quite possible that the mechanism of the injury is essentially the same as that which occurs in "charley-horse," which is due to a sudden movement when the person is off balance.

Dr. D. F. Winn of the Army Medical Corps recommends strapping with adhesive tape to hold the injured tissues in a fixed position and the application of heat regularly to insure a good blood supply and aid recovery. The use of an elastic stocking as a support to the adhesive is sometimes helpful.

Road Tar Poisoning

A MAN about thirty years old was tending a tar wagon; he left the wagon temporarily and some mischievous children opened up the escape valves of the boiling tar. The man ran about a third of a mile to the tar boiler, and found a lake of tar on the road, covered by clouds of fumes. He waded through the fumes to shut off the valves, breathing deeply because he was out of breath. After coming out of the fumes he became violently ill with convulsions, and has since had repeated hemorrhages from the lungs. Acute inflammation of the kidneys developed, later a severe anemia, and finally disturbances of the nervous system.

Road tar, as has been emphasized by Dr. Carey P. McCord, is a combination of chemicals left after coal-tar distillation. When applied repeatedly to the skin it causes irritations such as tar cancer. Because of the chemicals involved in tar, almost every one of the systems of the human body may be affected. The benzene portion of the tar has a specially destructive effect on the blood and may be responsible for the hemorrhages and anemia. From coal tar, phenol, also known as carbolic acid, is derived. When taken into the body, it is extremely caustic. It will burn the tissues with which it comes into contact. After the poison enters the system convulsions follow. From coal tar also are derived various anthracene products. When these are taken into the system, there results a water-logging of the lung tissue. There are many industries in which coal tar and various derivations, beside those that have been mentioned, such as toluol, naphtha, benzene, and aniline, are concerned. Workers with such substances learn to treat them with respect because they soon become aware of their dangerous possibilities.

Decaying Teeth in Childhood

CHILDREN anywhere from six to ten years of age frequently develop a process of decay in their teeth which results in a rapid loss of many of the permanent teeth in the older children. In younger children, the first teeth are destroyed rapidly and the second teeth come in crowded, crooked, and with defects leading to their early break-down.

It is generally conceded that a break in the enamel of the tooth is an important factor in early decay. From time to time various bacteria have been alleged to be of importance in causing early decay of the teeth, but a specific germ has not as yet been isolated which is invariably associated with such processes. As pointed out by Drs. Julian D. Boyd and C. L. Drain, sometimes the teeth decay under the best of mouth hygiene.

These investigators studied tooth decay in the State University of Iowa College of Medicine, and came to the definite conclusion that dental caries depends on dietary inadequacy, such as is sometimes associated with the food intake of the average child. They were led to this view by the fact that diabetic children who were put on good diets began to recover promptly from tooth troubles.

They point out that the average child is generally allowed to use his appetite as an index of his food needs, and that his menus are determined by the choice of foods offered to him. An analysis of the average diet showed it is deficient in vitamins and mineral salts, sometimes to a marked degree. The giving of a diet that is rich in mineral salts and in vitamins resulted in the stopping of dental caries in 28 diabetic children, 82 percent of whom had shown definitely progressive decay of the teeth prior to the giving of a correct diet.

The Colors of Foods

NOT the smallest part by any means of the attractiveness of any diet is the natural color of the food substances that may be concerned. The red of the apple, the blue of the plum, the yellow of the banana, the orange color of the lemon, orange, and grapefruit, the green of the spinach, watercress, lettuce, peas, and string beans, the red of the tomato, and the yellow of carrots are significant in our appreciation of these fruits and vegetables. Butter of a pale and ghastly hue is so unattractive that artificial coloring is permitted in butter substitutes. Indeed, coloring is such a significant part of the diet that it would be practically impossible to devise a meal of pure white constituents.

The investigators in physiologic chemistry have been studying the coloring matter of foods with a view to finding out if these have any other usefulness in the body than the esthetic one. In addition to the green chlorophyll of plants, the leaves contain two pigments, xanthophyll and carotin, which form yellow solutions. These pigments are found also in corn, carrots, and sweet potatoes. They are practically always found together but in varying percentages. Their occurrence in the yellow of the egg or in milk, is dependent on the food that the chicken and the cow may eat.

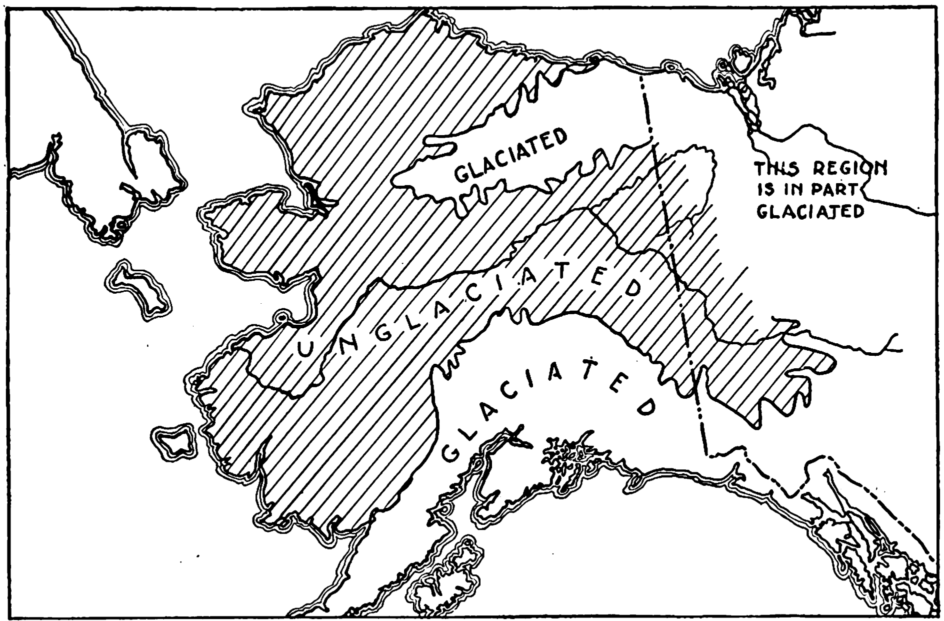
Drs. F. P. Underhill and L. B. Mendel of the department of physiologic chemistry in the Yale University recently conducted experiments in which dogs were fed a diet from which carotin was absent. These dogs developed symptoms of malnutrition which disappeared when the animals were fed as little as five milligrams daily of crystallized carotin. Here is a problem of great interest to the scientist on which as yet but little research has been done. So varied and complicated are the constituents of our diet and so new is the science of dietetics that only a small beginning has as yet been made in securing the vast amount of information that must be available through research into dietetic problems.

The Search for the First American

Most Anthropologists Accept the Theory that Man Reached the New World by Way of Alaska. New and Immense Excavations for Gold, if Given Attention, Might Also Reveal Evidences of This Early Emigration

By ERNEST N. PATTY
Dean, Alaska Agricultural College and School of Mines

IT is a matter of common geologic knowledge that during the late Pleistocene Epoch great ice sheets formed in Canada and then moved southward to cover the northern tier of states. Lobes from these continental glaciers extended as far south as Kentucky and Missouri. Obviously a gradual but great migration of animals must have resulted to the southward, ahead of these slow ice invasions.



Redrawn from U.S.G.S. Professional Paper 45

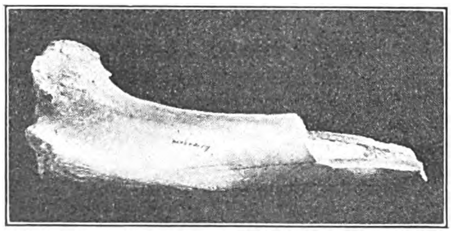
NOT ALL OF ALASKA WAS COVERED WITH ICE

According to Dr. Ernest Antevs (see "The Last Glaciation") there is no reason to suppose the Pleistocene climate of Alaska was more rigorous than the climate of Alaska today

If at the time of maximum glaciation we had been privileged to make an aerial exploration it is probable that we would have found 90 percent of the northern half of our continent covered by these vast ice caps. Some set of paradoxical geologic events, however, caused the Yukon Basin of interior Alaska to escape these widespread invasions. At the time when the New England States were being ground beneath the heel of the ice king, the interior of Alaska formed a verdant oasis nearly surrounded by a sea of ice.

When the writer first visited Alaska he expected to find the interior section shaped by glaciers into a glaciated type of topography comparable to that of eastern Canada. Field studies in the Fairbanks area and in other sections of the Yukon drainage basin revealed, on the contrary, a positive absence of glacial carving and of glacial debris. An examination of the excellent bulletins of the United States Geological Survey indicated that the Government geologists had recognized this phenomenon years ago. But as far as I know, special attention has not been directed toward the unusual absence of continental glaciation in this sub-arctic area.

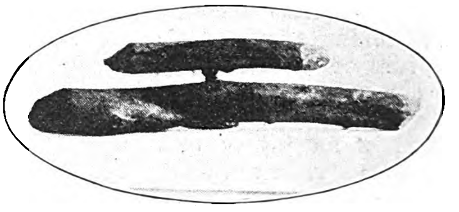
This protected basin was menaced on two sides by great ice sheets. From the southward the serrate Alaskan Range forced gigantic valley and piedmont glaciers down into the lowlands. From the north the precipitous Brooks Range and the less rugged Yukon-Tanana Highlands attempted similar invasion. Apparently there were warm summer winds traversing the Yukon Basin, which first checked and then vanquished these ice invasions. The low, open country where the Yukon and Kuskokwim deltas merge with Bering Sea, would offer favorable admission for these warmer summer winds from the Pacific. Possibly a better explanation exists, but the above appears most obvious.



PERFECTLY PRESERVED

Note central marrow. Even an ancient man, if soon frozen, would have been preserved in the frozen Alaskan soil

If these conditions prevailed we would expect that the Pleistocene mammals of the northland would seek refuge in great numbers in this protected basin. Such a deduction is confirmed by the fact that placer gold mining operations beneath the stream valleys of the Yukon Basin are uncovering profuse skeletal remains of these mammals. Undoubtedly, during the glacial period, the valleys of interior Alaska teemed with animal life.



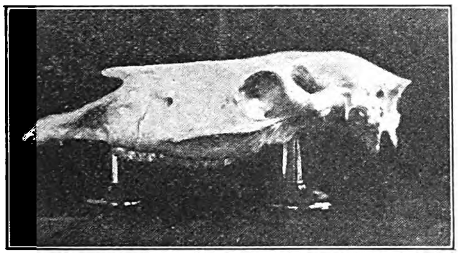
ANCIENT BEAVER CUTTINGS

These pieces of wood in perfect condition were found 20 feet beneath a valley floor

Well preserved skeletal remains of the hairy mammoth, northern bison, Pleistocene horse, musk ox, elk, caribou, bear, and beaver are found when the placer miners delve beneath the valley floors in search of gold-bearing stream gravels. These finds are not restricted to certain areas but they constitute usual occurrences in practically every valley explored in the Yukon-Tanana drainage basin.

The bed rock under these streams is floored with a deposit of gravel varying from 6 to 40 feet in thickness, and this gravel in certain areas contains sufficient placer gold to make mining profitable. It is a fortunate coincidence that these animals were caused to travel over gold-bearing gravels. Otherwise we would have but scant knowledge of their presence.

The Yukon and Kuskokwim rivers constitute the ultimate drainage conduit of all water falling in interior Alaska. During the glacial period the Yukon apparently was dammed, possibly by a glacier advancing across a constricted place in its valley. This damming caused the water to back up into the tributary valleys and convert these valleys into temporary lakes. A muddy ooze collected in these lakes. Later, the barrier dam gave way, the water receded from the tributary valleys, the ooze-like sediment that remained was permanently frozen and a mat of vegetation developed, effectively insulating the frozen ooze from the summer sun.



PLEISTOCENE HORSE

This skull was found with mammoth remains 40 feet below the valley floor

This frozen mud-ooze the miners call "muck." When the protective mantle of moss and nigger-head grass is stripped from it, the muck thaws in the sun and changes into a semi-fluid ooze which can be easily swept away in suspension by running water. It is this frozen blanket of muck, 20 to 200 feet thick, covering the gravels, which hampers the placer miners—they must penetrate it and often sluice it away before they can work the auriferous gravels beneath.

When the miners penetrate the muck with prospect shafts they use steam points for thawing and occasionally as the muck is thawed it emits an offensive odor of decaying flesh. Bits of hide with the hair intact are sometimes encountered in the muck. The skeletons are in some instances complete, with the marrow still present in the larger bones. In other instances only fragmentary bones such as the more resistant femurs and skulls predominate. No doubt a careful search would reveal the bones of smaller mammals, but it is the larger bones that attract the attention of the miners. Until very recently these miners have been the only collectors in the field.

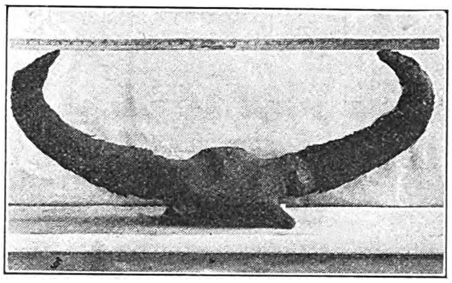
Most of the skeletal remains are found near the base of the muck, while others are immediately at the junction of the gravels with it. This would lead to the inference that these animals were traveling on the gravel bars when they met death and that subsequently they were covered by the muck.

In places, a veritable bone yard of different animal remains is found in a small patch. However, the evidence indicates that these animals did not meet death by some isolated catastrophe. Rather it suggests that with the flooding of the valley floors they retreated to the adjacent hills, and an occasional animal returning to the water's edge would become bogged-down in the muddy ooze. Possibly this explains the abundance of bones of the massive animals such as the hairy mammoth and the northern bison and the paucity of remains of the caribou, bear, and horse.

All of these animals would survive the present climate of interior Alaska. With the exception of the hairy mammoth, northern bison and Pleistocene horse, they did survive the glacial epoch. The musk ox roams today on the barrens northwest of Hudson Bay; the caribou and the bear are of widespread occurrence in Alaska; and the beaver with his engineering bent, continues to build his dams along the same design that his ancestors formulated some 50,000 or more years ago.

We know that the mastodon was plentiful in the United States at this time, but apparently he did not flourish in Alaska. In the museum of the Alaska College there is one well-preserved set of mastodon teeth which a prospector discovered on a gravel bar in the Yukon River, four years ago. This is the only evidence that the writer has seen which indicates that at least an occasional mastodon took refuge from the descending glaciers in the Yukon Basin.

All of this opens a more significant and important possibility. Many paleontologists have suspected that man inhabited the North American continent during the glacial epoch, but so far no positive evidence has been unearthed to substantiate this theory. The commonest and most logical inference is that primitive man migrated from Asia, probably crossing Bering Straits to Alaska and then pushing slowly southward.

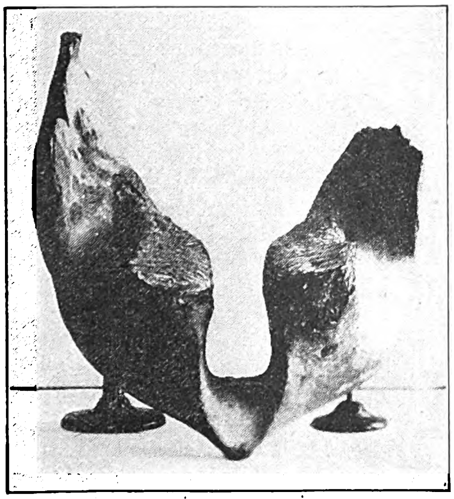


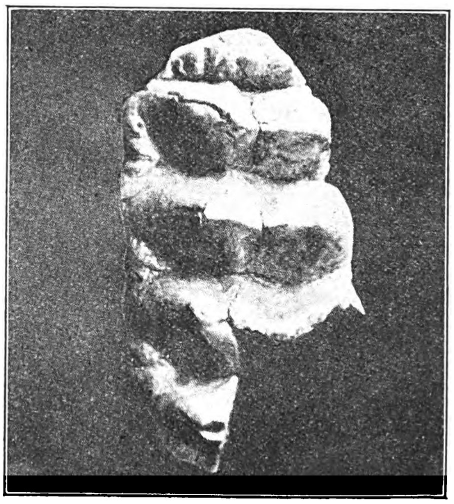
NORTHERN BISON

The horns measure 29 inches from tip to tip. This animal is now extinct

On a clear day the coast line of Siberia is visible from Cape Prince of Wales, and only an expanse of 40 miles of water separates the two continents at this point. The Eskimos today, in their skin boats (*umiak*) regard such a journey as routine travel in ordinary weather. If primitive people traveling along the shores of Siberia saw the hills of Alaska looming up across the water, it is only natural that they would eventually cross over and investigate this new country. To them, as Hrdlicka pointed out, it would not be the migration to a new continent—simply to an adjacent body of new land which might offer better prospects for hunting. Once in Alaska their southward migration would require centuries of time to become impressive, and their line of travel would be either along the shores of Bering Sea or up the Yukon River. If they were in Alaska during the glacial period these would have been the only two routes available.

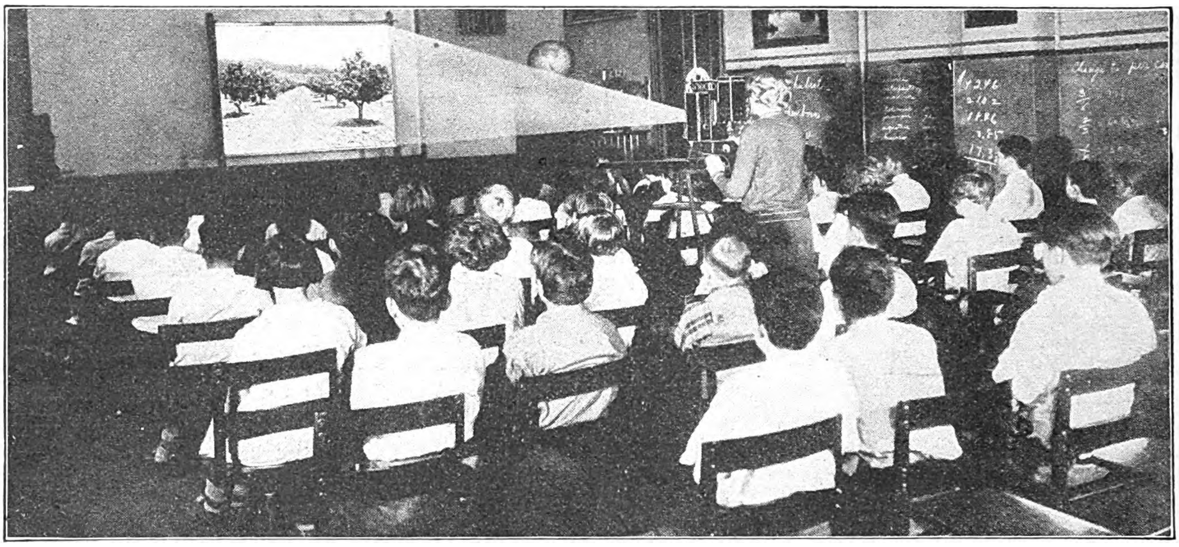
With these thoughts in mind it is highly desirable that more scientific attention should be payed to the frozen gravels and muck of the valleys of interior Alaska, for it is an easy matter without such attention to pass by positive proof of man's existence here during the glacial epoch, should they occur here.





< **TWO KINDS OF TEETH** >

At left, jaw and teeth of the hairy mammoth. Note corrugated surfaces. At right, tooth of a mastodon, very different from those of a mammoth. Mastodon means "nipple tooth." Note "nipples"



EDUCATION IS ACCELERATED BY INSTRUCTION WITH THE AID OF CLASSROOM FILMS

Education Adopts the Motion Picture

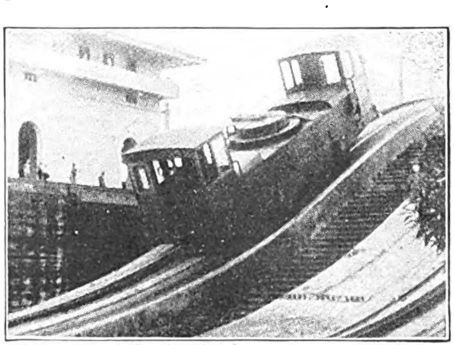
Films Prepared to Supplement the School Curriculum Prove Their Worth in Education's Greatest Experiment

By ELIZABETH RICHEY DESSEZ

FOR many years the educational value of the motion picture has been recognized. However, many problems have confronted the teacher who has wanted to adapt films to subjects taught in school curricula, and the producer who has considered the production of pictures for classroom use. From the viewpoint of the teacher, the outstanding problems have been the high cost of projection equipment and films, and the scarcity of pictures produced or edited for instructional purposes. For the prospective producer of educational pictures, the main stumbling block has been the limited and unorganized demand for such films, which cannot be produced and distributed without a large investment. Fortunately this situation has undergone a change, slowly at first but increasing rapidly in the past few years.

WITH the co-operation of outstanding educators, several companies are now selling or renting educational and classroom films which meet the needs of the educational world—films of real educational value, at moderate prices. Of the companies now engaged in making educational pictures, there are four which are outstanding: the Eastman Kodak Company, the De Vry Corporation, Pathé Exchange, Inc., and the University Film Foundation.

Pathé, the oldest motion picture company in the United States, has been engaged in this educational work the longest. This firm's large library of negatives includes much valuable scientific material—records of expeditions to many countries, the pictures of the important historical events of the past two decades, and so on, which had been filmed by news-reel cameramen all over the world. This company secured the assistance of experts at the United States Department of Agriculture in the preparation of pictures on commercial geography; and scientists at the American Museum of Natural History co-operated in the editing of a series on nature study. During the past two years, the Division of Anthropology and the Department of Geology and Geography at Harvard University have co-operated with the Educational Department of Pathé in the production of two series of pictures, one on human geography and one on physical geography. These pictures are edited by graduate students employed by the company. Dr. Ernest A. Hooton and Dr. Kirtley F. Mather, members of the faculty at Harvard, supervise the work and approve each finished reel.



Courtesy Eastman Teaching Films, Inc.

ELECTRIC "MULE"

This scene was filmed at the Panama Canal as an aid in commercial geography

Shortly after the Harvard-Pathé contract, the University Film Foundation was incorporated, to engage solely in the production and distribution of teaching films on a non-commercial basis. This group also made an agreement with Harvard, and certain professors and graduate students are preparing educational films. The Foundation has an ambitious program of production and is under the direction of John A. Haeseler, who has been working with educational films for some time. Its work will be watched with considerable interest.

THE Eastman Kodak Company approached the field of visual education in a scientific manner. Some of the other producers of educational pictures who had started at a time when educational pictures were in their infancy, had been forced to advance slowly by the trial and error method. Mr. George Eastman decided to learn all he could about educational pictures before his company embarked on a program of production. One of his first steps was to secure one of the country's most eminent educators, Dr. Thomas E. Finegan, to be president of the Eastman Teaching Films, Inc.

Under his supervision, and sponsored by the National Educational

Association, a most comprehensive and scientific investigation was conducted, which has been called "the greatest experiment in the history of education." The purpose of this experiment was to provide facts from which could be determined the exact educational value of specially prepared classroom films, whether the company would be justified in adopting an extensive program for producing such films, and whether the films could be produced at a cost within the purchasing power of the schools.

Dr. Finegan enlisted the services of Dr. Ben D. Wood of Columbia University and Dr. Frank N. Freeman of the University of Chicago. Both men had the confidence of the teaching profession of the country. More than 10,000 pupils in 12 representative cities participated in the experiment. It is particularly noteworthy that all of the films used in the schools during the investigation were originally produced and edited according to scenarios written by experienced educators specifically for classroom use. The tests were conducted under standards which are recognized in educational circles as modern and sound.

THE results of the investigation furnish conclusive proof of the value of motion pictures in the classroom. The 5500 pupils in the experimental groups using classroom films, gained from 15 to 33 percent more than the 5500 equally competent pupils in groups which did not have the films. The experiment provided the desired information as to the value of properly prepared motion pictures, and since that time the Eastman company has been producing additional classroom films and will eventually be able to provide such pictures for all academic needs.

It is hardly necessary to say that the educational and motion picture worlds have benefited tremendously from the experiment. It justified the faith of those who were convinced of the value of films but had never been able to prove it. The test encouraged those whose faith in educational films had begun to waver, and convinced many confirmed sceptics among the teachers and film producers that teaching with pictures could be made beneficial and profitable to both.

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RECONSTRUCTING THE REVOLUTIONARY WAR

Films depicting notable events in American history are popular in many schools. This scene, from one of the historical pictures, shows British soldiers parleying with their allies

The experiment also demonstrated conclusively what thoughtful educators had proclaimed: that motion pictures are not educational in themselves. They are a very valuable supplement, but only a supplement, to the teacher's equipment. Unless the teacher follows the simple instructions for using the films, and makes them a regular part of the classroom routine, they are merely a diversion and their use is more of a detriment than a help.

The De Vry Corporation, which of the three commercial companies is the newest in the field, is primarily a producer of cameras and projectors. Seeking a market for its product, it did not take this company long to see that educational motion pictures must be available if projectors were to be sold. The supply was limited, and consequently De Vry became a producer of educational films, enlisting the advice and approval of scientists at the American Museum of Natural History and of geographers at Teachers' College at Columbia University.

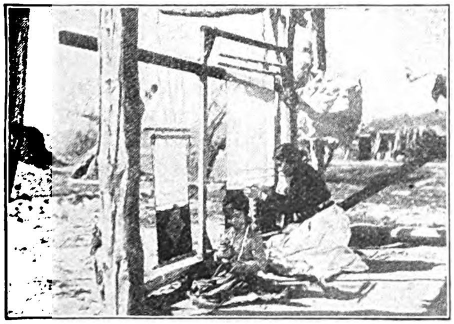
PATHÉ, Eastman, and De Vry supply teachers' aid pamphlets with all pictures for classroom use. These give outlines of what the pictures contain, the titles and scenes as they appear on the screen, and the application of the pictures to the courses of study with which they are to be used. Advice is given the teacher on how to present the film, and suggested collateral reading for the class is also furnished. The pamphlets are prepared by experienced teachers and have received the endorsement of all who have used them.

Last, not in order of importance, but because of a character different from the other projects referred to, mention must be made of the Chronicles of America Photoplays. These pictures of the outstanding episodes in the history of the United States, produced by the Yale University Press under the direction and supervision of distinguished historians at Yale and other universities, have been extensively used in both public and private schools and in colleges all over the country. The Department of Education at Yale has conducted—and is conducting—extensive experiments with the pictures in this series in order to determine the most effective means of teaching history with motion pictures.

The development of easily operated portable projectors and the use of non-inflammable film stock on the smaller and consequently cheaper size (16 millimeters) has done much to bring educational pictures into use.

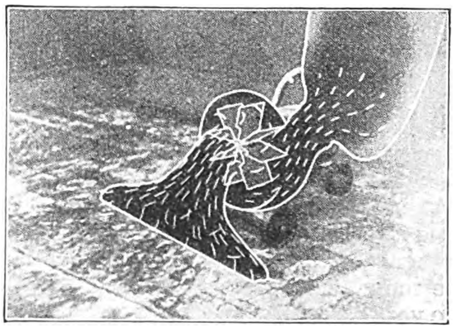
Within a few more years films will be available for all branches of learning. What science will bring forth within the next few years cannot be foreseen. Already the talking picture is causing a reorganization of the whole industry. The third dimension in photography and pictures in natural colors are on the threshold, and other more remarkable developments may come.

It is now certain that motion pictures will assume an increasingly important role in education. Their worth in the classroom has been proved; their future is assured.


Courtesy Pathé Exchange, Inc.

INDIAN WEAVER

One series of educational films shows the people of all lands at work and at play


Courtesy Eastman Teaching Films, Inc.

HOW THINGS WORK

Animated drawings are used in a number of films adapted to general science courses

Pointers From a Pen Maker

A Fountain Pen Combined With a Mechanical Pencil Is the Latest Successful Product of a Veteran Inventor

By MILTON WRIGHT

"THERE are two main courses for any inventor to take. He can sell or lease the products of his brain to other people, getting in return a payment in cash or a royalty, or he can make and sell the invented article himself. By the first course he can make some money—in some cases a considerable amount of money, but, of necessity, the great bulk of the profits from his ideas go to someone else. Only by keeping in his own hands the business revolving about his invention can he realize fully the possibilities there are in it."

So says Julius Schnell, who probably knows more about the making of fountain pens than any man living. Schnell should know whereof he speaks, for he has tried both courses—first letting other people make the major profits from his work, and later running his own business founded on his own inventions. His newest product is the latest development in fountain pens—the combination fountain pen and pencil.

WE knew of Schnell's reputation; we had heard of how he had been making nationally known fountain pens for other manufacturers and of how at the age of 58 he had decided to throw overboard all the steady profits he was making and plunge into a new business. The story of his experience, it seemed, ought to have something of value in it for the rest of us. We sought him out.

"Just how big is the fountain pen business?" we asked, by way of getting started.

"There are twenty million pens manufactured every year in this country," he replied. We were inclined to argue the point. At that rate pens would have been made in six years for every man, woman, and child in the nation. Now every man, woman and child doesn't have a fountain pen. Furthermore, the people who do own fountain pens often keep them for years. The quantity seemed too big.

"Every year two and a half million pens are lost and three million are broken," Schnell explained. "There are more pens made every year than the year before. That steady record of increase has been going on since the first fountain pen was made in France in 1846."

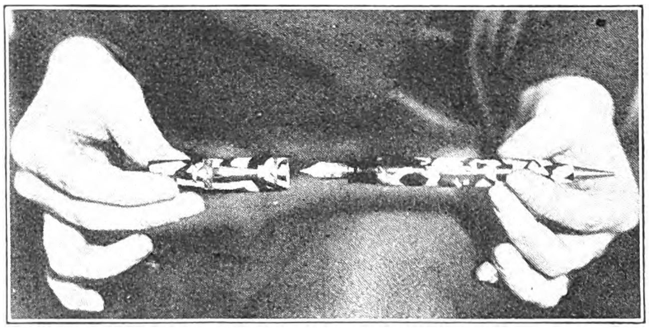
"But twenty million is a lot of pens in one year, and, of course, they must be sold in rather small lots."

"Not so small as you might think. The American Telephone and Telegraph Company recently gave me an order for 75,000 pens."

"But what could one company do with so many pens?"

JULIUS SCHNELL

He has learned that inventors profit by becoming manufacturers of their products



A USEFUL AND BEAUTIFUL HYBRID

In addition to combining the fountain pen and the mechanical pencil, the inventor patented a new clip and filler

"Place one in the hands of each employee. The telephone company has found that it is bad business for the employees to make notes with lead pencils. They get marked up or rubbed out and many a valuable memorandum has become illegible or lost. The company's executives figure that money is saved by having all reports made in ink. They assign a fountain pen to the employee and if he loses it he must replace it at his own expense; if he leaves the company he must turn it in."

This was interesting, but it was getting away from the purpose of our visit, which was to find out how this inventor and manufacturer in the field of fountain pens had made such a success. To get back again we asked:

"How did you happen to get into this business?"

"Like most practical inventors, I was a mechanic," he answered. "I had learned to be a machinist and tool maker in Alsace, where I was born. When I came to this country at the age of 21, I went to Akron, Ohio, because I had about 250 cousins there, none of whom I had ever seen, but all of whom I wanted to meet. It took me six months to visit all of them.

"The B. F. Goodrich Company seemed a rather ideal place for me to work, for a rather unique reason. They had a mighty good employees' band and I wanted to join it. They welcomed me with open arms because I could play four instruments—the flute, the piccolo, the clarinet, and the trombone. In the shop I made more money than any of the other men because I was an expert tool maker.

"AFTER a time I quit. Being young and restless, I drifted to Cincinnati, where I got a job with O. E. Weidlich, manufacturer of fountain pens. Sometimes, when business wasn't so good, he would "hang me up" for my salary. I wasn't very fond of that quaint custom, so I left him to go with John Holland, famous pen maker back in the nineties.

"The Swan Pen Company heard of various things I had been doing to speed up the making of pens and sent for me in 1897 to enter their New York factory. I stayed with them until 1903, when I opened up a little shop of my own to make fountain pens and parts for manufacturers."

"Was there much fountain pen work to do in 1903?"

"Not in comparison with the size of the business today. The fountain pen was still in its infancy. My first order came from Cleveland for ten gross of holders. Then I saw Edward Todd and Company and they promised to buy ten gross a week. The next year I contracted with the Conklin Pen Company. Their first order was for ten dollars' worth of holders. It was so small that I investigated to see if it wasn't a mistake. That was all it was, but two years later I signed a contract with them for 600,000 holders. At 36 cents per holder that was a pretty big contract for me in those days.

"In 1912 Schaeffer came east and developed his patents. The next year he wanted me to join forces with him and go to Fort Madison. I couldn't see leaving New York and so I passed up my first chance to become a millionaire."

"How did you get orders for pen holders?"

"The manufacturers knew me and every fall I would go on the road, show them some new ideas and come back with orders for 700,000 or 800,000. In 1917 a strike upset the fountain pen business generally, but I was paying my workmen more than others were, so I had little trouble. There were then about 60 men in my factory."

ONE OF THE FIRST STEPS IN MANUFACTURING

Grinding and boring the composition material used in making fountain pens. It takes just 28 seconds to produce a complete combination pen and pencil with modern machinery

"IF business was going on so smoothly, Mr. Schnell, why did you think of changing your methods?"

"Because I could see that it might not always go smoothly. Do you remember the Dunn pen? It was a big seller several years ago. I had a contract with Dunn for a half million holders. When he failed I lost a lot of money and I realized that it would not only be a lot more profitable but a lot safer to be in business for myself. I began waiting for an opportunity."

"And what was this opportunity?"

"A new product. One day about four years ago a man named Wilhelm came into the factory, showed me a combination pen and pencil and asked me if I could make it. It was almost identical with the model of a combination I had made back in 1892 and then had forgotten about. I got it out of the attic and found the date scratched on it. Wilhelm and I might have had a row about it but we were both reasonable and decided to join forces and look around a bit to see how we could put the combination pen and pencil idea over. I made some new models.

"WILHELM was traveling out west. In Dallas he interested Clarence M. Wheeler, a real estate operator, in the idea and Wheeler came east and decided to join forces with me in manufacturing and selling the new combination article, which we decided to call the Penselpen. Wilhelm developed other interests and we bought him out.

INSTALLING THE RUBBER SAC

In order to utilize the full capacity of the rubber sac, an improved device for filling the pen was invented. Most pens are lost or broken before they wear out

"There was a lot of work to be done. The pen holders had to be perfected. Many of them would get broken when the cap was unscrewed. I experimented a bit and fixed that up. I got a patent on a new feed bar. Then I got a patent on a new filling lever, making it easier to fill the pen, than by any method heretofore known. The public took to the new article from the start.

"The clip on the average fountain pen is not durable, so I began groping for a new one. The day Lindbergh took off for Europe the idea came to me. Why not, I asked, design a clip to look like an airplane? I did it. It was a beauty. Not only did it look good, but it wouldn't break, any stress on the shank of the clip being distributed out along the wings. Two days after my patent was issued a lawyer came to the factory and offered me 10,000 dollars for it. Fortunately, I didn't take his offer, for that clip is our biggest selling feature. It sells 75 percent of our holders."

"How many pens have you made altogether?"

"In my time I have made more than twenty million pens. I made three quarters of a million for Dunn, one of my biggest customers."

"How many patents have you taken out?"

"Seven. The first was on an ink feeder. I got that in 1903."

"Did you make money on any of your patents?"

"I made money on all of them."

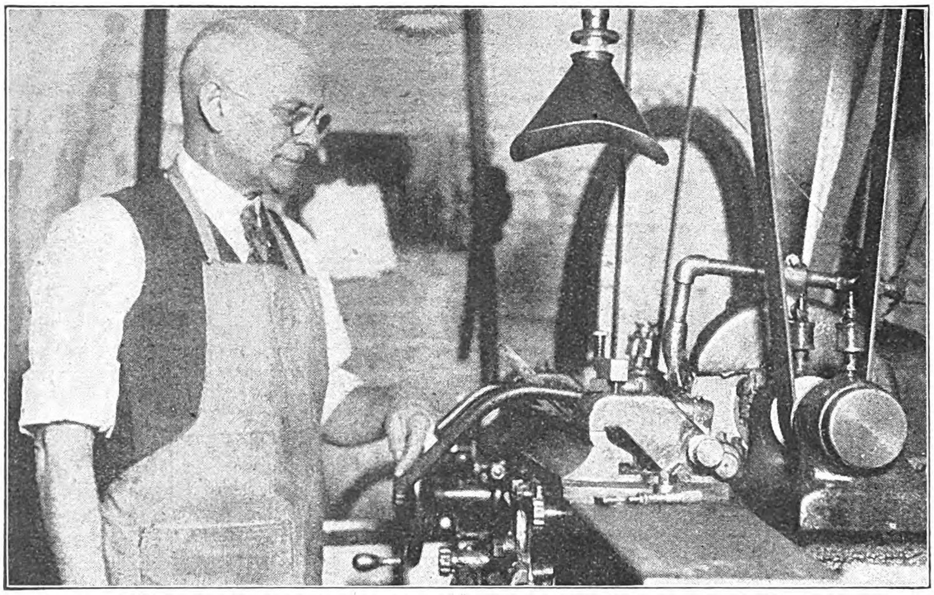
"How?"

"I WOULD incorporate the new feature on each pen holder and add five or six cents to the price to the manufacturers. They were glad to pay it."

"That has amounted to a good deal of money, hasn't it?"

"Yes, but not enough. In five years I can make more money working for myself than in 20 years not working for myself. That is true of any inventor. I really believe it is safer, too."

We went through the factory. Here was a machine grinding down and polishing tubes for the pen barrels. Water kept playing upon them throughout the operation to keep the friction from overheating them. Next we saw little white rings being sweated on caps for purposes of ornamentation. These rings are a waste product of condensed milk. Now we saw them inserting hard-rubber pen sections, the little



THE INVENTOR-MANUFACTURER IN HIS FACTORY

Mr. Schnell explains that his success as a pen-maker has resulted from introducing a popular new product in a field where the competition was keen and the demand almost unlimited

parts that fit under the gold tips. Over at another machine they were polishing pen barrels made of a combination embodying fish scales; these are the mottled black and white pen barrels which suggest mother-of-pearl, so popular now. Two final polishing wheels, one covered with muslin and one with flannel put the finishing touches on the barrels. These wheels, by the way, are made from parts of Ford automobiles. And so it went, down to affixing the airplane clips, inserting the rubber sacks, adding the pencil tips, adjusting and inserting the gold points, and all the rest of it down to the final inspection.

"How long does it take to make a pen and pencil combination?" we queried.

"Twenty-eight seconds."

"How long would it take one man if he made it all?"

"THERE are only 12 men in the United States who can make a fountain pen complete. Working with all the latest equipment, it would take one of those 12 about three and a half hours. Working without machines, it would take him two days."

"Do people find the combination pen and pencil much more convenient than a pen and a pencil separately?"

"Not only more convenient, but more efficient. One of the banks in New York made a practical test recently with two entry clerks. One man was given a pencil and a pen and one man a combination pencil and pen. In the course of a day, it was found, the man with the combination did 30 percent more work than the other.

"People buy pens for lots of reasons. I know of one man who ships these combinations to Africa every month where they are exchanged for ivory tusks. Sometimes a man will buy a pen because he likes its looks, even if he doesn't need one. Color has an effect on sales of pens. Would it surprise you to know that 85 percent of the red-headed men who buy pens buy red ones? Women buy pens to match their manicure sets. Recently many men have been using two pens, one to go with a desk set and one to carry in the pocket."

"From your experience, Mr. Schnell, would you say that it pays to be an inventor?"

"It has paid me and I believe it would pay every inventor where the same conditions are present as were present in my case. In the first place, the inventor must know his particular industry thoroughly. He must know how things are made and sold and he must be able to judge what will appeal to the public and what will not.

"In the second place, the inventor must be in a field in which there is a big demand. The more competition there is, the better it is for the man with a new idea. And in the third place, the inventor must have adequate patent protection.

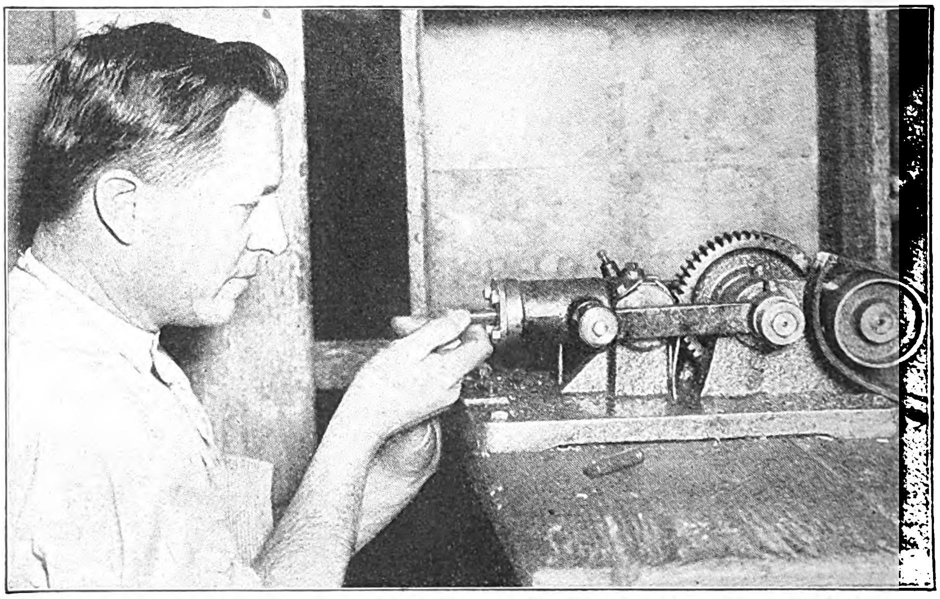
"Yes, there is money in inventing. There is more money, however, in manufacturing. Where the same man is both inventor and manufacturer, and the invention is something the public wants, then that man is sitting on top of the world."

"WHO would you say is the original inventor of the fountain pen as we know it today?"

"That is something that is lost in the dim mists of antiquity. The ancient Egyptians had a kind of stylus which carried its own supply of ink and ever since then men have been trying all sorts of ingenious devices to obviate the necessity of dipping into ink.

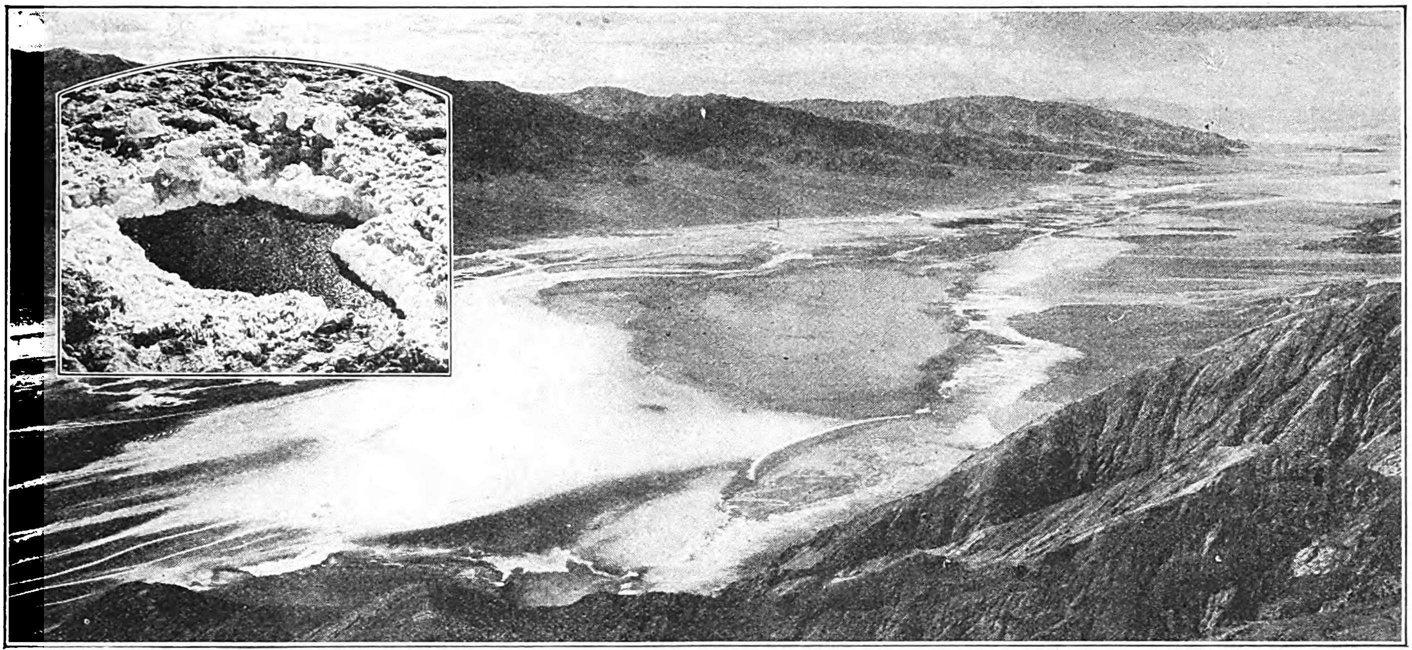
"When Lewis Edson Waterman applied at the Patent Office for his grooved-rubber feed device, he found that about a thousand patents on fountain pens had been issued before his. There have been still more issued since. It isn't the number of changes that are made in fountain pen designs that count, however; it is the merit of the particular invention that marks real progress. Waterman made a distinct advance in the art, and the profits he made were deservedly great. I have reason to believe that I, too, have made inventions that are improvements.

"Inventors sometimes are measured by the number of patents they obtain. I know of one man who has obtained more than 80 patents and has never made a dollar out of any of them. He is not practical. I know other inventors who have concentrated on one invention. They are the ones who have succeeded technically and financially."



SWEATING METAL BANDS ON PEN CAPS

After the bands are attached to the caps, another machine polishes them. The popular black and white barrels for pens and pencils are made of a composition embodying fish scales



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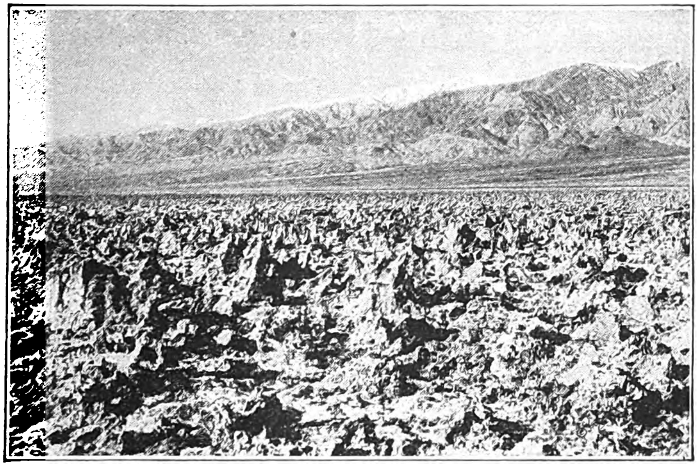
NOT A MIRAGE, BUT THE SANDY FLOOR

What appears to be a great body of water is in fact the sandy floor of Death Valley in California. This majestic picture, showing an area of approximately 70 miles, was taken from Dante's Point. The small inset illustration shows part of one of the salt beds of Death Valley



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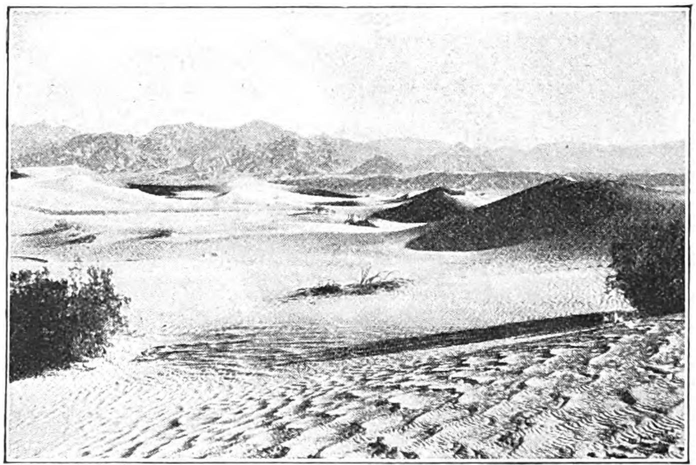
THE DEVIL'S GOLF COURSE

This is a long dusky lava ridge with, in the background, the fanciful fairy-land architecture of the frost king on Telescope Peak



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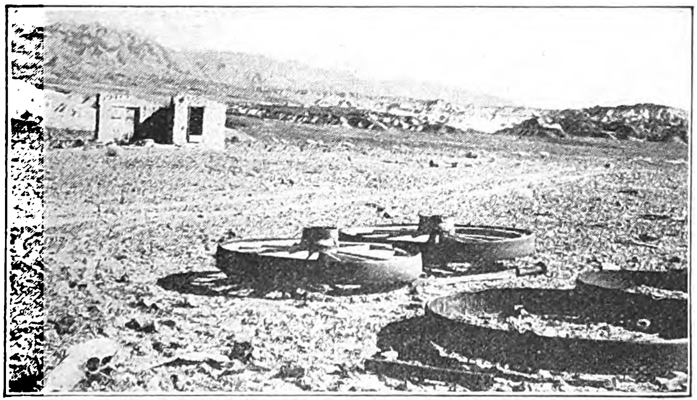
THE SHIFTING DUNES

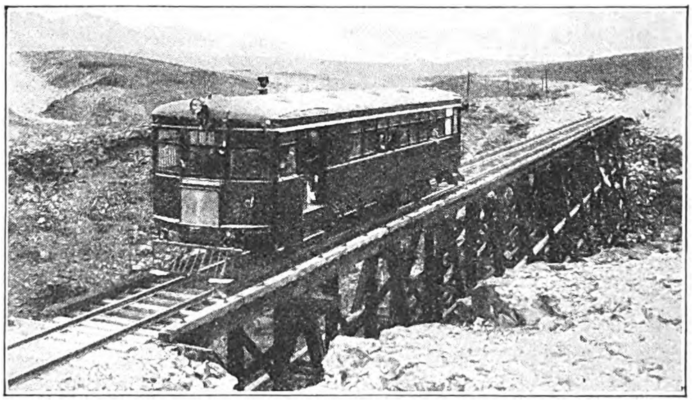
The dunes of Death Valley assume queer shapes of pyramids and rippled waves. Stunted vegetation holds its own for a time



All photographs courtesy All Year Club of California

TWENTY MULE TEAM DAYS

When the old twenty mule teams were abandoned, the wheels remained as mute evidence of an obsolete means of transportation

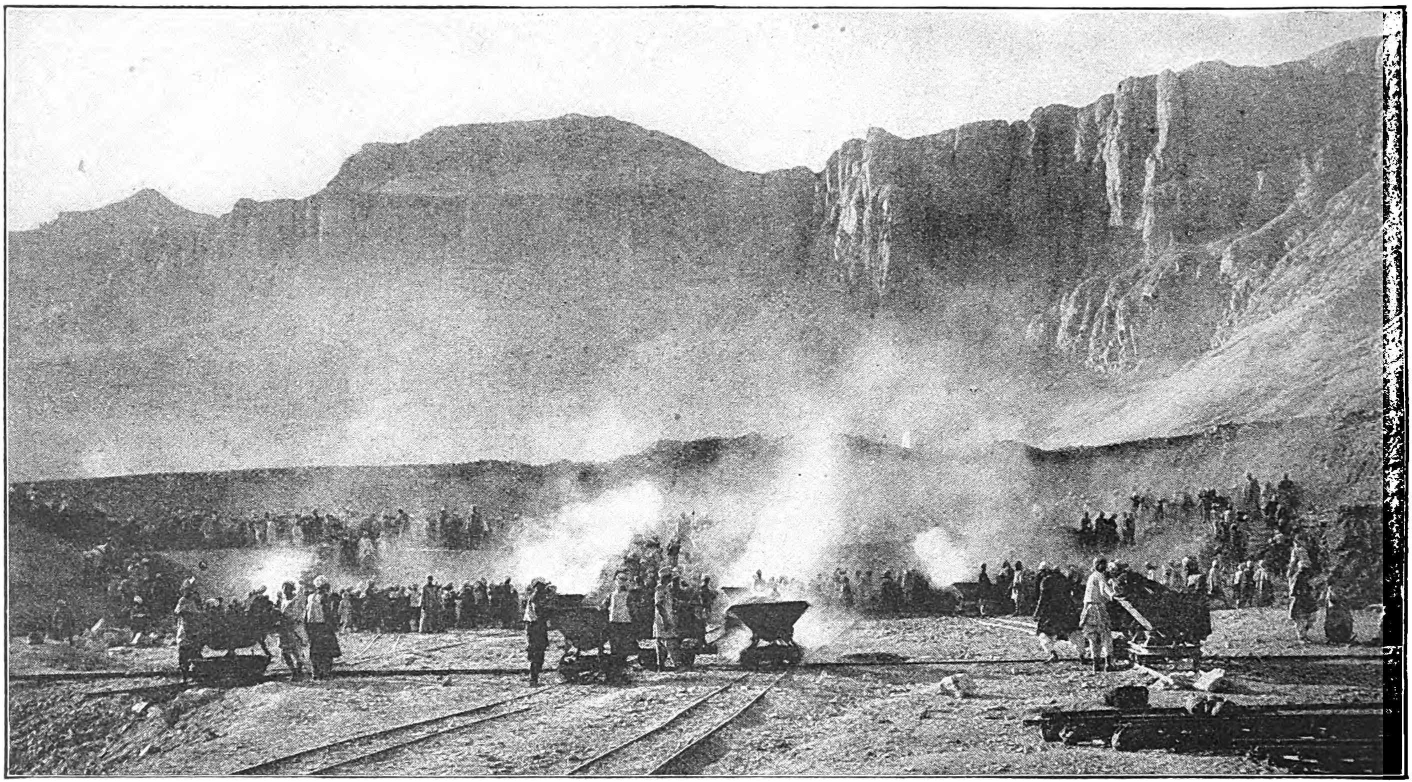


GASOLINE MOTOR COACH

There is a 36-inch gage railway in Death Valley. The gasoline motor coach on rails is admirably adapted for tourist purposes

The Mystery, Desolation, and Grandeur of Death Valley

IN summer, Death Valley is one of the most forbidding places on earth. Nowhere else on the globe do the temperatures range so high in midsummer. It is a torrid, almost lifeless region of barren, burned-sand desert and treacherous salt marshes, a place of sand storms, mystery, adventure, tragedy. In the old days the graves used to bear this epitaph: "He ran out of water." Now, however, tourists are carried about in motor coaches on rails, and in motor busses on roads. Excellent hotel accommodations are offered the venturesome tourist in this strange region.



All photos courtesy Metropolitan Museum of Art

CARTING AWAY A FORMER EXPLORER'S DUMPINGS

When the explorer Naville began to clear the Temple of Deir el Bahri, at Thebes, in 1893, he dumped 1,800,000 cubic feet of dirt. The Metropolitan Museum's expedition had to clear away this dirt to find the broken statues. Picture shows the rail heads and workers

Egyptian Vandalism 3400 Years Ago

How Posthumous Fame was Denied to a Female Usurper of the Throne of Egypt

FROM year to year we chronicle the activities of the Egyptian Expeditions of the Metropolitan Museum of Art. In our issue of January, 1929, we called attention to the adventurous career of Queen Hat-shepsut who was the very ancient prototype of Queen Catherine of Russia or the late Empress Dowager of China. Therefore, we shall confine the present article to the Museum's excavations at Thebes which are so graphically described by Mr. Herbert E. Winlock of the Egyptian Department in Section II of the *Bulletin of the Metropolitan Museum of Art*.

In 1893, when Naville began to clear the Temple of Deir el Bahri, he cut a gap through the temple wall, and ran his light railway down to the steep side of the deep burrow-pit where he discharged his cars into the hollow without investigating what lay below, which he was steadily burying still deeper. In this way he disposed of some 1,800,000 cubic feet of dirt. The expedition's task at the beginning of the season was to explore the side of the quarry throughout the 260 odd feet covered by Naville's dumping operations. This meant the removal of about two thirds of the dump and, under it, of a layer of natural drifted sand on the quarry floor which the excavations of the previous year indicated as being less than seven feet thick. This was estimated to mean the moving of more than 1,400,000 cubic feet of dirt. The eastern half of the old quarry furnished an ideal place for disposal.

It was not found necessary to sift or otherwise examine the material dumped by Naville. This made for fast work. Tracks were laid so as to give six or even seven rail-heads at the face of the work. The diggers worked at two levels as shown in our. illustration. Seven hundred men and boys were employed at the excavation. Various difficulties which were met are described by Mr. Winlock, and when the camp was closed May 1, 1928, the thermometer was registering 110 degrees in the shade.

THE task of piecing together the fragments was a long job and of course could not be completed in one season. Some of the pieces were no bigger than the tip of the finger, while others had to be handled by derricks as shown on our cover. The story of the finds as told by Mr. Winlock in his own words is as follows:

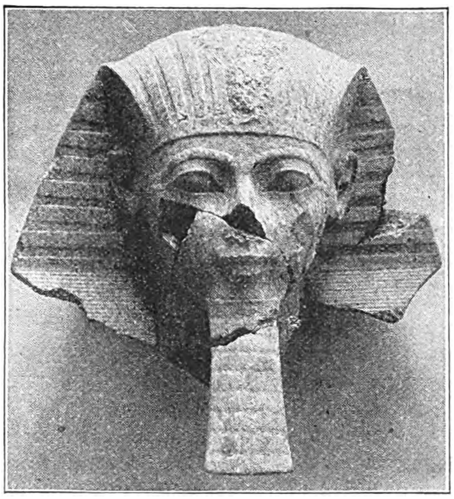
"When King Thut-mose II died, about 1501 B.C., his place was taken upon the throne of Egypt by his little son, Thut-mose III, and the regency was intrusted to his widow, Queen Hat-shepsut. Hat-shepsut was the daughter of King Thut-mose I; she was the stepsister as well as the widow of Thut-mose II, and she was not only the step-mother and aunt, but the mother-in-law as well, of Thut-mose III, through his marriage with her daughter, Nefru-Re. And when to all these complicated connections with the throne, she added an indomitable character and an ambitious following among the Theban courtiers, it is not surprising to find that, instead of surrendering her regency when Thut-mose III came of age, Hat-shepsut usurped the titles of a sovereign ruler of Egypt. She claimed to have been declared heir to the kingdom during the lifetime of her father, Thut-mose I, and immediately set about building a temple at Deir el Bahri where she and her father were to be worshipped together.

"For 12 years at least Ma-ka-Re Hat-shepsut was the ruler of Egypt, with Thut-mose III leading as shadowy an existence as a Japanese Mikado under the Shogunate. And then, in

1479 B.C., she died. Immediately the name of the usurper was expunged from the official chronicles and Thut-mose III decreed that every mention of her and every portrait of her should be erased from all visible monuments. Above all, her temple in Deir el Bahri was turned over to the wreckers. The structure itself might not be destroyed because it was dedicated to the god Amun, but her name and her portraits were obliterated from all the walls, and her statues were hurled down and taken away bodily for destruction and buried in every convenient waste space and hollow outside the sacred precincts.

"WHENEVER we told the visitors to our excavations the tale of the destruction of the statues of Hat-shepsut, we could see complacent little smiles at what they, with their mature modern culture, seemed to consider the childishness of the ancient Egyptian. And yet, every once in a while modern man has taken a little fling at inanimate things quite in the spirit of Thut-mose III. Perhaps it is not altogether fair to go so far back as to cite the vicissitudes of the statue of Charles I at the head of Whitehall in London—sold for junk by Parliament under the Commonwealth and bought by an individual who was astute enough to keep it intact until he could sell it back to Charles II at the Restoration.

"More nearly in the spirit of the successor of Hat-shepsut was the affair of the statue of George III in Bowling Green in New York. Not only was it torn down on the night of July 9, 1776, but, to add injury to insult in a way to have delighted the heart of an ancient Egyptian, the lead of which it was made was cast into bullets to shoot at King George's soldiers. Still nearer our own day was the case of the name of "Jefferson Davis, Secretary of War," chiselled off the Washington aqueduct when he became President of the Confederacy. That was, I believe, as official an act of the Federal Government as the erasures in Deir el Bahri were of King Thut-mose III.



RECOVERED FROM THE DUMP

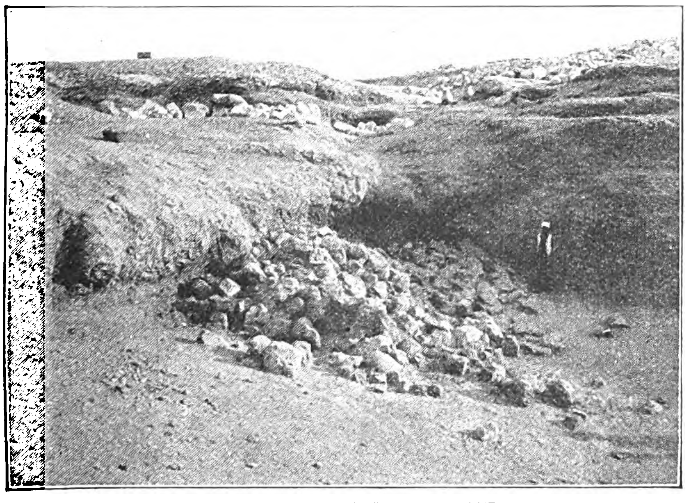
Matching up pieces is exciting business. This is the head of a red granite sphinx

"And finally, even during this last war, the names of everything from Hamburger steaks to royal families were altered in a fervent desire to suppress memories of the enemy, and it was nothing short of a triumph of emotional suppression when the authorities in Washington merely took the statue of Frederick the Great from the terrace of the War College and put it down cellar, instead of converting it into brass shell fuses. Perhaps we are getting a little tamer than Thut-mose III—but we can hardly pretend as yet that his actions are entirely incomprehensible to us, when we find him destroying the statues of his mother-in-law.

"Our discovery of this cache of broken statues at Deir el Bahri promised to be of prime importance. Of course it could not be comparable to the great cache of Karnak, where the statues of that enormous fane had been buried under the Persian conquest. There, in one hole, had been unearthed sculpture which had accumulated throughout the 15 centuries from the Middle Kingdom to the Saite Period. In our find, the statues would be all of one date, and, in fact, of one person—Queen Hat-shepsut—but in that very fact would lie a certain interest. Deir el Bahri Temple had been planned by one man, the architect Sen-en-Mut, and it had been built in one operation with its sculpture an integral part of its design. Even if we could not recover all of its statues and its sphinxes, we stood an excellent chance of finding the greater part of them, and thus of being able to reconstruct Sen-en-Mut's scheme in its entirety. Furthermore even if those statues which we might find should be broken, the breaks would be clean, and easily repaired, and, thanks to their having been buried while they were still new, many of them would still retain their coloring.

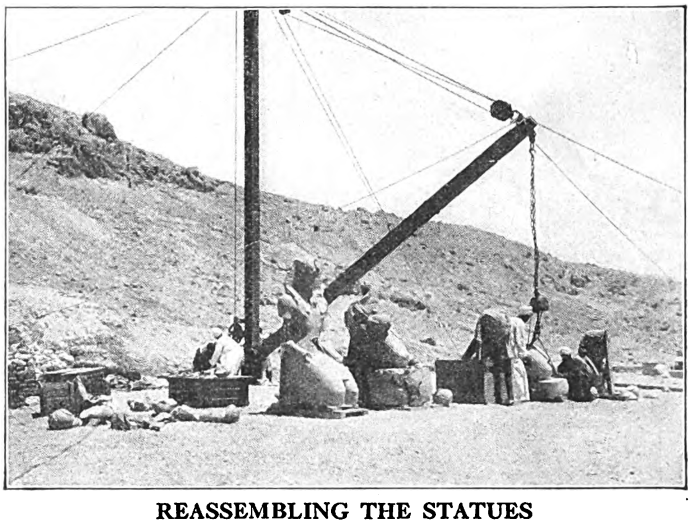
"The amount of destruction to which the original wreckers had subjected Hat-shepsut's portraits varies a good deal. Always the uraeus—symbol of kingship—was battered away. Sometimes the face was almost totally destroyed, and at other times only the eyes were pecked out and the nose knocked off. Occasionally, with a smaller statue, they were content merely to break the head off without bothering to damage the features at all. On the whole, the damage is not so disfiguring as it might have been. The two standing statues could be reassembled almost entirely except for their bases. One of the colossal kneeling statues lacks only the base and the two hands.

"IN one respect the mutilation and the burial of these statues have actually worked for their preservation. They were not more than five years old at the time of their removal. They had not been exposed long enough to the elements to become weather-beaten, and their early burial served in many cases to preserve their paint almost intact.



SINK-HOLE IN QUARRY

On the floor of the quarry many fragments were recovered from quantities of earth thrown over them by a former explorer



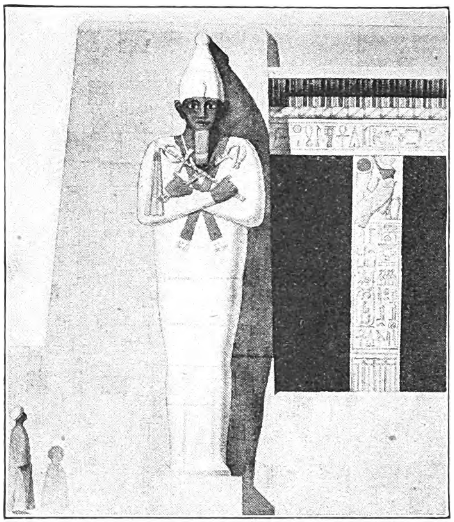
REASSEMBLING THE STATUES

Here we see the use of American tackle and differential block helping along the slow work of adjusting the pieces of the statues

"Possibly the reader to whom the story of Hat-shepsut is unfamiliar will be somewhat puzzled at the mention of a beard, and at the virile cast to some of these portraits. Now and then we have found heads which can be taken without much question as being feminine, while other statues are uncompromisingly masculine. The explanation lies in Hat-shepsut's ambiguous position. A woman could not be sovereign of Egypt, and if she attempted to usurp the position she must hide her sex from posterity, even if she could not hide it from her contemporaries. It is a commonplace to the student of Egyptian history, therefore, that Hat-shepsut was represented as a king. To the student of Egyptian history our identification of these statues will cause no surprise, and in many cases the inscriptions on them can leave no doubt. Elsewhere throughout the temple the portraits of the founder were on every hand. We are reasonably certain that there were at least 12 little kneeling statues. We know of three large seated statues.

"DEIR el Bahri Temple was not only a shrine of the god Amun; it was, in addition, intended as the temple where the dead Hat-shepsut would receive her provisions for eternity. Dead, she was one with the god Osiris, and hence it was appropriate that she should appear in Osirian guise as a mummy, holding in her hands the crook and flail which Osiris carried. In such guise we have found her portraits continually, and our workroom shelves are stocked with fragments of every description, all of the most brilliantly painted limestone.

"There was an Egyptian funerary custom that we have had occasion to refer to more than once in these reports. After the body had been embalmed and wrapped in its bandages by the undertakers, all of the embalming materials which were left over were gathered up and packed in jars which were carried to the necropolis and buried somewhere near, but never actually in, the tomb.



A RECONSTRUCTION

Here we have the reconstruction of a colossal statue nearly 24 feet high

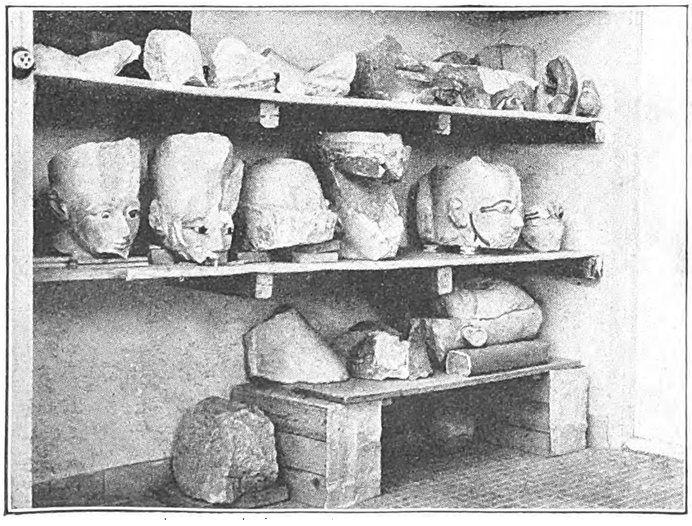
"When we were digging in the Deir el Bahri quarry, we found that the western end of it had begun to drift up with wind-blown sand as soon as the quarrymen had abandoned it. In the course of time a bank of sand several feet thick had accumulated in a semicircle around the end of the quarry nearest the temple, and as we dug into it we found numbers of large round-bellied jars, stoppered with mud, buried in rows in this sand-drift. When we came to open them, each jar was found to be filled with bundles of natron or of sawdust, with soiled rags, with broken cups which had contained oil, and frequently, with the sweepings of the floors of the embalmers' shops. These sweepings were far from pleasant, even in retrospect, but they gave us some very obvious clues as to the underlying idea in this custom. The Egyptian undertaker was a careless and venal workman and if a person wanted to be sure that the whole of his mortal coil attained a safe burial, it was as well that even the sweepings of the embalming shop floor should be gathered up.

"We had in our storeroom several similar sets of pots from previous years and for days our time was taken up entirely with examining and recording the contents of some 200 such jars, and the baskets and hampers buried with them. Years ago we had found a wooden table which had been used for the embalming of the body of the Wazir Ipy of the Eleventh Dynasty.

"This year we had to deal with several mats which still bore the stains of the aromatic oils used in such a process. These mats were just the size of the sleeping mats of the modern peasants, and in one case we found a very much crushed, but still recognizable, wicker bed on which some old Theban worthy had been laid out.

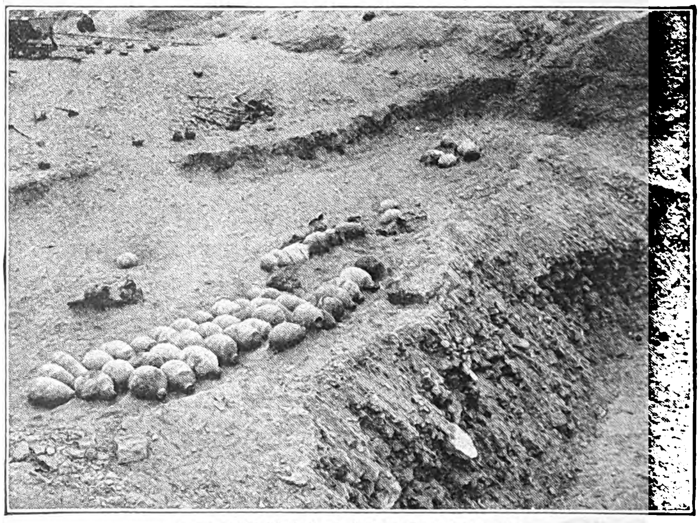
"The jars themselves were of several different shapes and often showed signs of having seen hard use before they arrived in the hands of the undertakers.

"PROBABLY just about the time that the pots were being buried—or a little later—some thief who had made a haul in a house in a nearby village was looking for a hiding place for his loot, and lit upon the sand drift in the quarry. He had a cook pot incrusted with soot outside and not so well scoured inside but that there were still some traces of the last dish for which it had been used. He had one of the massive bronze anklets which women of the Meroitic Period affected, and which were so heavy that a rag had to be worn under them to keep them from chafing the wearer's ankles. And he had two curious bent metal tubes, one of iron and the other of bronze. When the latter was brought to New York and cleaned by Dr. Fink (Columbia University) it turned out to have a sieve on one end and was evidently a siphon for sucking beer out of a deep jar."



A WELL-FILLED CLOSET

A corner of the workshop where fragments of statues await assembling as the pieces are found. The results have been remarkable



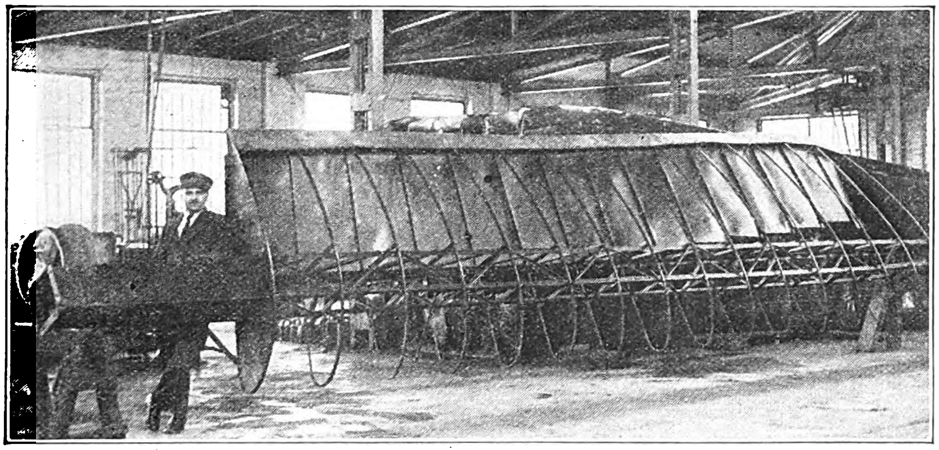
UNDERTAKERS' WASTE JARS

A curious side-light on Egyptian manners. The jars frequently contained sweepings from the floors of the embalmers' shops

Aerodynamic Wind Mills

Airplane Science is Applied to Wind Mills for Greater Power and Efficiency

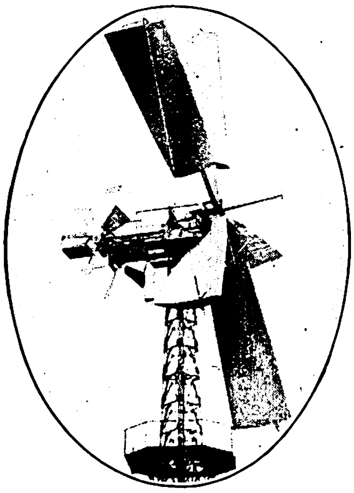
WIND mills of the older countries of the world, and especially of the Netherlands, have for centuries furnished man with free power with which to grind grain, pump water, and do other jobs requiring more power than man could supply. With the advent of the steam engine and of electricity, the inefficient, low-power wind mill was superseded to some extent even though its power was free. In isolated sections or in localities where fuel is expensive and electricity lacking, it has held its own and is still in use. Various improved forms are commonly used in this country.



STRUCTURE OF THE NEW WIND WHEEL BLADE

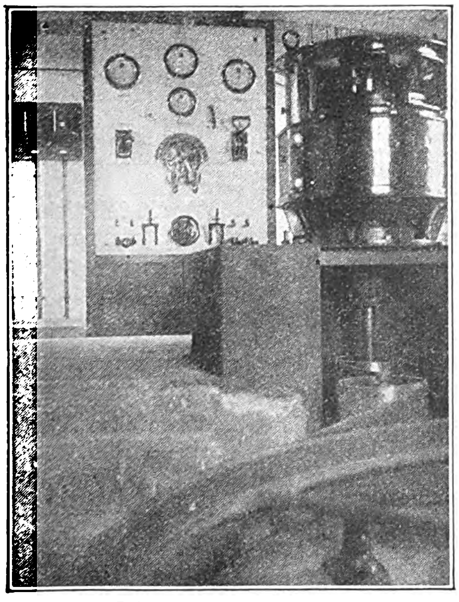
The size of the wind power-plant wheels described here is indicated by this blade which shows method of construction. It is similar in design and construction to an airplane wing

For the first time in history, however, the aerodynamics of the airplane have been applied to the design of wind mills in order to achieve a higher efficiency. The Kumme system of wind power plants, recently introduced into this country, is of German design based on the researches of Professor L. Prandtl, of Goettengen, and his collaborators, Dr. A. Betz and Dr. Ackert. The blades of the wind wheels of these power plants are shaped to eliminate wind congestion and whirling air currents. Their pitch is regulated by the wind itself—that is, the blades rotate about their longitudinal axes according to the wind pressure. Thus a wheel of this type will generate considerable power even where winds are light. On the other hand, high winds will not wreck one of them nor cause the generator to speed up excessively.



"VANE" WHEELS

The two wheels which hold the main wheel into the wind. Note blade thickness

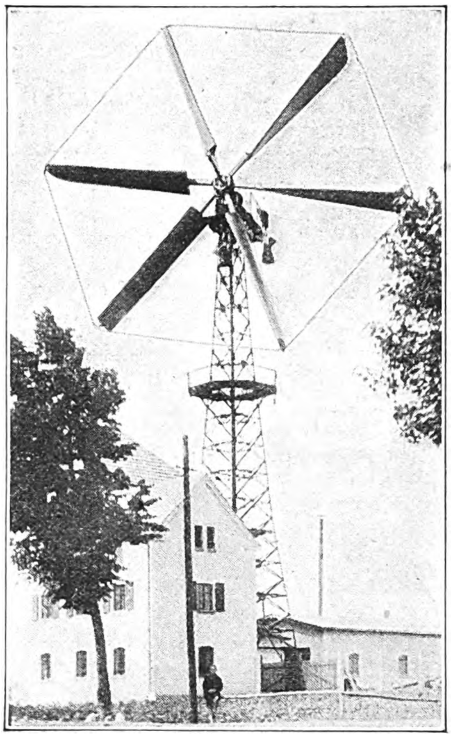


GENERATOR ROOM

The great drive wheel and belt, the vertical-shaft generator, and the switchboard

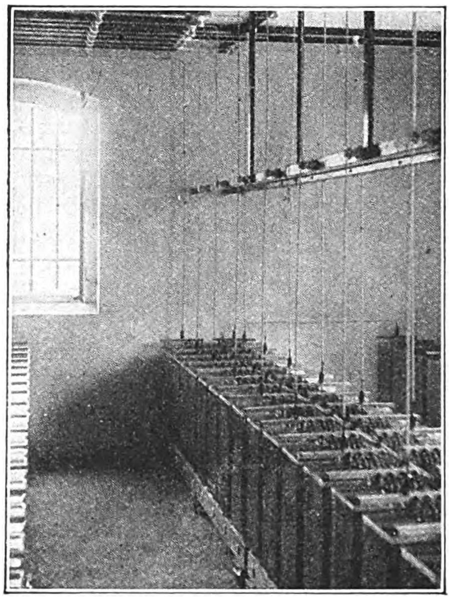
The wind wheels may have diameters up to 60 feet, while the tower must always be so high that the lower edge of the wheel is 14 feet above any obstacle. Two smaller wheels perform the work of a vane in holding the main wheel into the wind. The drive shaft from the wheel terminates in the generator room in a horizontal wheel of large diameter which, in turn, drives the generator by means of a belt. The generated electrical power is distributed to bus-bars on the ceiling of the plant. Excess electrical power is stored in large batteries, and a fully equipped switchboard controls the distribution system.

The Kumme system wind power-plants are built in sizes up to 300 horsepower. They are rapidly coming into use in many parts of the world.



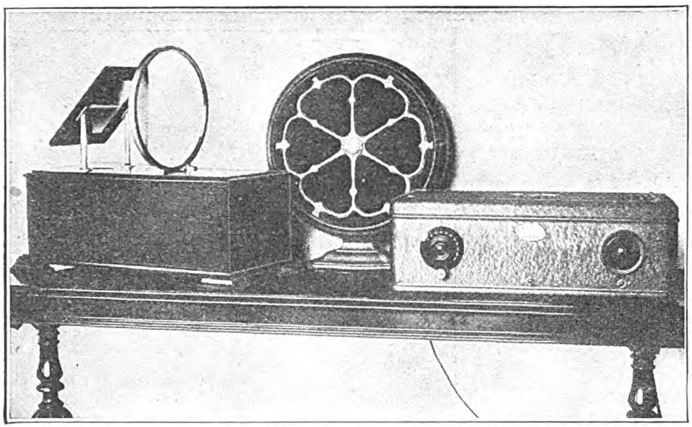
A TYPICAL INSTALLATION

An entire 2000-acre farm in Germany is electrified from this wind power-plant



STORAGE BATTERIES

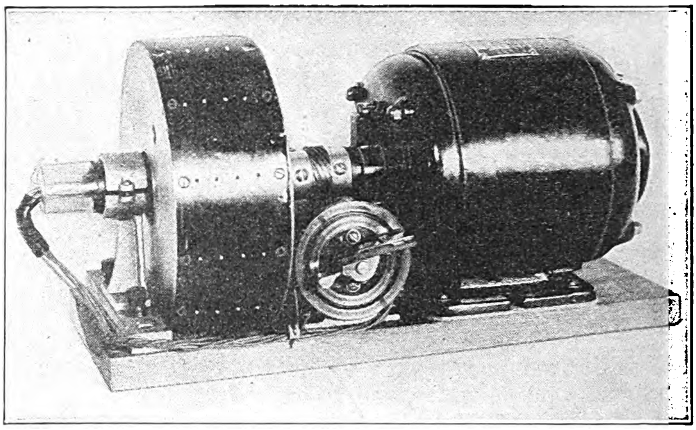
The wheels generate up to 300 horsepower. The excess power is stored in batteries



All photographs courtesy Jenkins Television Corporation

TELEVISION REPRODUCER

At the left of the standard radio receiver and loudspeaker is the vision apparatus. Picture is viewed in the mirror through the lens



MOTOR AND SCANNING DRUM

At the extreme left is visible the end of an unmounted four-element neon lamp inserted in the center of the perforated scanning drum

Television Advances

With Powerful Transmitting Stations Furnishing Radio Vision Broadcasts on Schedule, Receivers Are Being Developed and Tested by Thousands of "Lookers In"

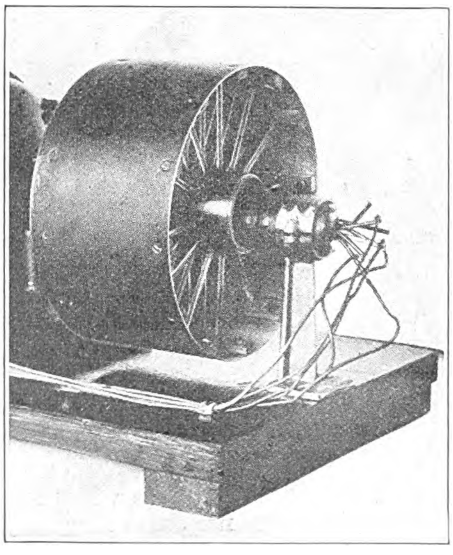
By A. P. PECK

AT about the time that this magazine reaches the reader, there will be in operation in Jersey City, New Jersey, a high-powered broadcasting station dedicated to television. Previously, there have been a few stations on the air with radio vision, but for the most part, these have been using low power and broadcasting for their own experimental purposes. But the new station mentioned is to be put on a regular schedule as soon as possible, and with the high power which is planned, there should soon be many thousands more "looking in" than there are at present.

IT is obvious that the erection of a large transmitter for television purposes would be useless, unless there was a move on foot to supply essential instruments for converting radio receivers designed for broadcast reception to use in television. And this is just what is being done. In the Jersey City plant of the Jenkins Television Corporation, production is going forward on a television unit or "radiovisor" which is designed to be connected to an electric light socket and to a standard multi-tube receiver capable of tuning to the wavelength.

The fundamentals of television are so well known, and have been described at such length in the pages of this magazine* that we will not take the space to go over them again. However, in the Jenkins reproducer, as it stands today, there are many novel points which merit description. In the first place, the point which most impressed the writer when first shown one of the reproducers, was its small size. This has been made possible by discarding the huge disk which has formerly characterized almost all television receivers. In place of it, C. Francis Jenkins, well-known inventor, has designed a small drum only about six inches in diameter. This drum, and the four-electrode neon tube used, can be seen in the photographs.

The curved surface of the drum is pierced with rows of holes, four to the row. These are so located on the drum that they serve the same purpose as the spiral of holes in the familiar television disk. Within the drum is placed the small neon tube, the feature of which is that there are four electrodes from which light may be obtained instead of the usual one. By using this type of tube with a mechanical current distributor, it is possible to illuminate each one of the electrodes in succession with only a fraction of the current which is required for satisfactory operation of the large surface of a single electrode tube. Therefore, such a tube can be operated from a multi-tube radio receiver without the use of a special high-power amplifier.



SILVERED RODS

Glass rods, silver plated, conserve the light by direct conduction to the holes

By employing a mechanical distributor to switch on and off the electrodes of the neon tube as the drum rotates, it is obvious that the specially placed holes will present the appearance of traveling in a spiral. Therefore, if a radio-vision program is being received, and the reproducer is in synchronism with the transmitter, there will be made visible a reproduction of the action at the transmitter.

ONE of the vital factors in television reception is the conservation of the light which is used to present the image. Since there is, at best, only a small quantity available, any unnecessary losses will seriously interfere with the efficiency. In the Jenkins "radiovisor," such losses have been reduced by conducting the light from its source direct to the holes in the drum. At first, fused quartz rods were used for this purpose, but their cost and the fact that they were not obtainable in quantities sufficient for production, led to the adoption of glass rods, silver plated. These have been found highly satisfactory, and are now used in all the reproducers manufactured. In the Jenkins "radiovisor" shown, a large lens is used to magnify the image somewhat, and to enable more than one person to view the "radio movie" at the same time.

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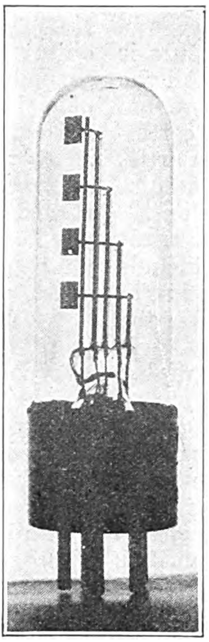
*See June, 1927, March, 1928, and December, 1928.

Possibly some of our readers have wondered at the writer's choice of the word "reproducer" instead of some such term as "television receiver." It must be stressed that any good radio receiving set is a potential television receiver. If it can tune to the wavelength on which television is being transmitted, and has a high-quality amplifier capable of passing a broad band of frequencies, it can be used with perfect satisfaction for television work. The only necessary adjunct is a television "reproducer" which is to be connected to the set in place of the loudspeaker—or possibly at the same time as the loudspeaker, when vision and voice are broadcast simultaneously. This reproducer, then—or might we call it a "visual loudspeaker"?—is what is now being produced for the future entertainment of the radio public.



NEON TUBE ➤

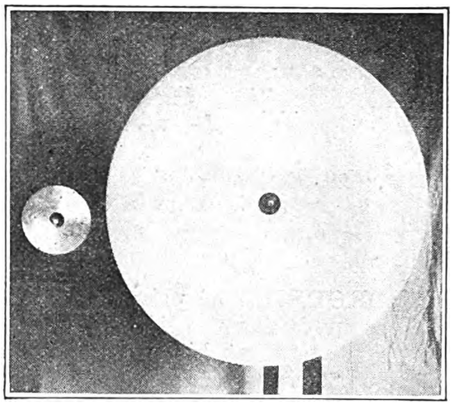
Four electrodes are used, but are not illuminated simultaneously. A current distributor feeds them in proper sequence

The transmitting equipment which is being used at the present time by the Jenkins company is interesting, as it makes use of motion-picture films and not actual settings and actors. At the time of writing, these films are made in black and white—silhouette—and not in shades of gray, as is the standard motion-picture film. They might be likened, in fact, to the animated cartoons with which all motion picture fans are familiar. These films are fed through a device which modulates the out-going radio wave. This device is shown in one of our illustrations. The film moves through it with a steady motion, and not the intermittent motion of a "movie" projector. As the film moves past a narrow slit located at a point where the film is bent in an arc of short radius, light reaches the surface through the holes in a scanning disk. This light passes through the film and acts on a photoelectric cell, causing a current to flow in the circuit of the cell. This current varies in strength according to the opacity of the film, and therefore can be used to modulate the carrier wave.

THAT television will repeat all over again the progress of sound broadcasting is a rather safe prophecy. For years, the fundamentals of broadcasting were known. Then music was put on the air. The only listeners were the comparatively few amateurs who were dabbling in radio—wireless—for their own entertainment and personal knowledge. They took up this new toy of voice reception with their usual thorough-going enthusiasm, and soon the public became convinced that radio broadcasting was something worth looking into. From then on, the development makes a story familiar to all. Without a doubt, the story of television will be much the same. With thousands of television reproducers in various locations throughout the country, much valuable data will be accumulated and this data will help to point the way to future improvements.

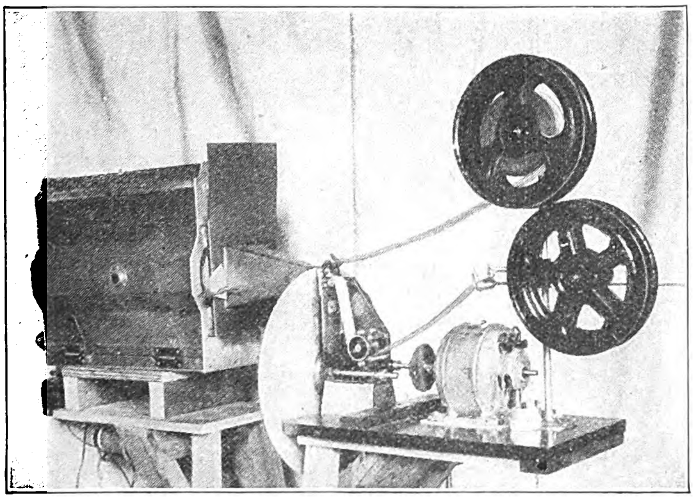
Although it has been said that the building of radio receivers in the home is dying out as a hobby, this may be only the natural result of perfection in manufacture. At the present time, it cannot be said that the same is true of television. There is no perfection, and such can be looked for only in the future. In the meantime, there are on the market, in addition to the complete receivers mentioned, kits of essential parts for the construction of simple television reproducers of the standard scanning-disk type. These contain the hard-to-get parts and enable anyone with some mechanical skill to build a reproducer which will give some interesting results.

RADIO experimenters and others interested in television, but unfamiliar with the present status of the work, must be warned not to look for perfect results or large pictures which can be shown to a group of admiring friends. The pictures so far reproduced with apparatus which is available for home use are small—in the neighborhood of one by one and one half inches—and often are not any too clear. But things like this are no deterrent to progress. Pictures can be received, and it will not be long before they will be bigger and better, and will approach perfection.



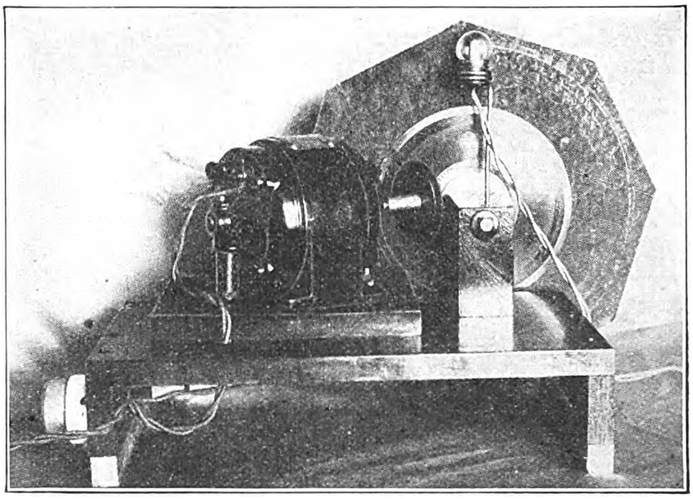
A COMPARISON

At left is the small, compact scanning drum; at right is an old-fashioned disk



RADIO "MOVIE" TRANSMITTER

The motion of the film is continuous, not intermittent as in motion-picture projection. The disk is perforated with a *circle* of holes



AN AMATEUR RECEIVER

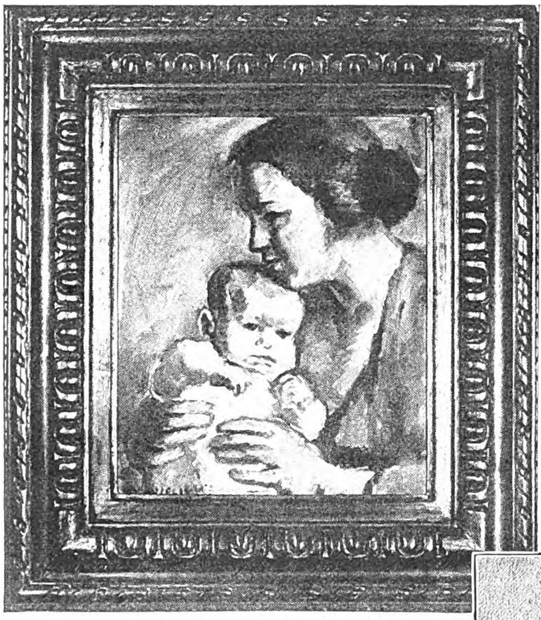
The scanning disk, neon lamp and support, disk shaft and bearings, and the friction-disk are now available in kit form at a low price

Protecting Paintings for Posterity

Various Branches of Science Are Combining to Foil the Arts of the Faker of Paintings

By **FRANCIS P. MANN**

FORGERIES of paintings often occur during the lifetime of the artist and at his or her death spurious pictures begin to appear on the market, if the works of the deceased painters are in demand. Posthumous fame is dear to all artists and a French society makes it possible to register a painting during the lifetime of the artist, and so provide a pedigree in writing, authenticating X rays, and photographs which will prevent any dispute at any time. This is the Société du Droit d'Auteur aux Artistes, or Society for Artists' Copyright. It is intended to protect the artist against all fraudulent practices in the way of imitations of his works.



REGISTERED

A certificate is issued and an enlargement is made of a certain part of the painting

This identification of a painting is made by calling upon all the varied resources of modern science and by the use of improved apparatus which is often specially designed for the purpose. It is the reverse of the process described in our issue dated May 1929.

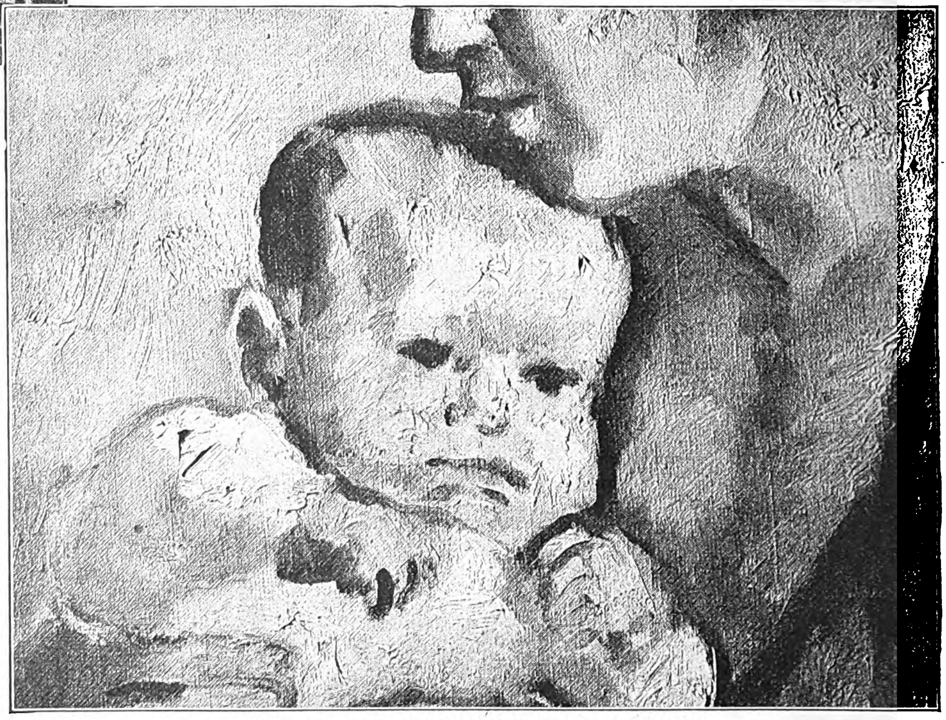
The society has assembled various technical experts who have already evolved highly valuable methods of research based upon the most modern scientific practice. This led to the founding of a special registration department, by which all works submitted by an artist could be examined and various records could be made by photography or X rays, or other scientific methods. Thus, each picture is given its exact identification. All the data and results for the picture are put on file, and an "identity certificate" is made out, of which the artist is given a copy. This record accompanies his picture on all occasions.

The documents on file, as a result of the laboratory examination, include various scientific records. The first of these is an ordinary photograph of the picture or other work. Then there is what is called a "metro-photograph," which is an enlarged photograph of a small square which is carefully located on the painting and is accurately measured from the edge of the painting. This small square is photographically enlarged and is valuable as identifying the brush strokes and all details.

What is known as the "metro-radiograph" is a record of a like square, but photographed with X rays which are directed through the picture upon a photographic plate. Between this and the ordinary photograph there is a striking difference, and this affords another means of identifying the painting and of conferring upon it the individuality which is the object of this system. Each photographic print is stamped with the official seal of the society.

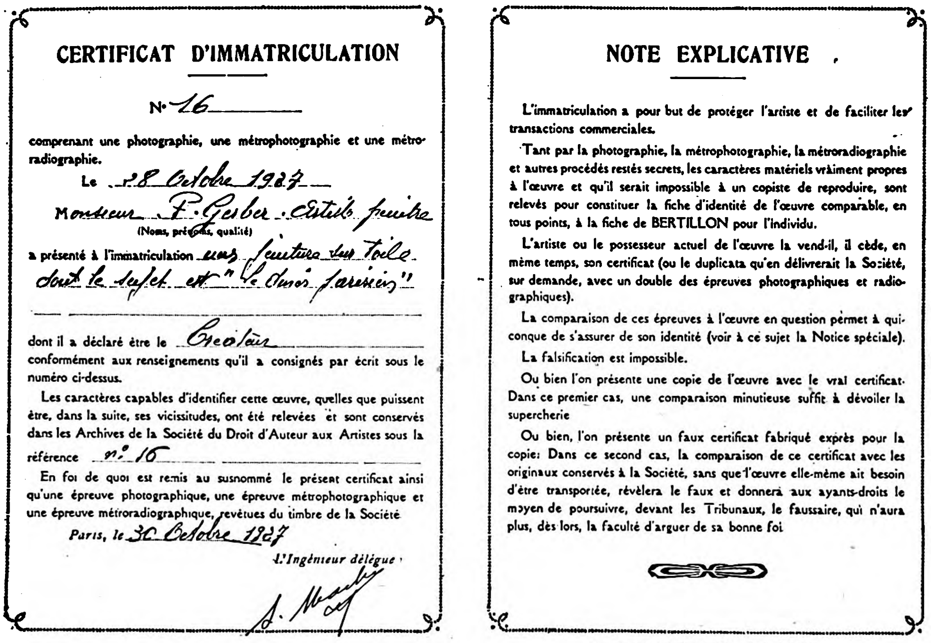
In the future, if there is any doubt as to the identity of a picture, it is referred to the society, where it is turned over to the laboratory. Usually a comparison with the "metro-photograph" will show up any differences, for all details are much enlarged. If there are still doubts, the picture is examined by X rays. This also shows all the faults and irregularities of the weave of the canvas. Two pieces cannot possibly be alike in such respects, and therefore the X rays form an excellent source of comparison in this respect. A suspected picture is X rayed, and the X-ray photograph of the original is examined to see whether the two photographs match as to the texture of the canvas. If so, this is undoubtedly the real picture; if not, it is a copy.

UP to the present time, in France, this class of research has been confined within the limits of judicial investigations, and to the special laboratory practice with which the name of Bertillon is associated. In other countries the same rule seems to hold, and it is only when matters are brought up in court that the judicial



THE PHOTOGRAPHIC ENLARGEMENT

Compare this illustration with the center part of the one showing the entire painting. Every brush mark and personal idiosyncrasy of the artist is visible for identification



CERTIFICAT D'IMMATRICULATION

N° 16

comprenant une photographie, une métrophotographie et une métroradiographie.

Le 28 Octobre 1927

Monsieur P. Gerber artiste peintre
(Noms, prénoms, qualité)

a présenté à l'immatriculation une peinture sur toile dont le sujet est "Le Amour parisien"

dont il a déclaré être le Créateur
conformément aux renseignements qu'il a consignés par écrit sous le numéro ci-dessus.

Les caractères capables d'identifier cette œuvre, quelles que puissent être, dans la suite, ses vicissitudes, ont été relevées et sont conservés dans les Archives de la Société du Droit d'Auteur aux Artistes sous la référence n° 16

En foi de quoi est remis au susnommé le présent certificat ainsi qu'une épreuve photographique, une épreuve métrophotographique et une épreuve métroradiographique, revêtues du timbre de la Société

Paris, le 30 Octobre 1927

L'Ingénieur délégué

NOTE EXPLICATIVE

L'immatriculation a pour but de protéger l'artiste et de faciliter les transactions commerciales.

Tant par la photographie, la métrophotographie, la métroradiographie et autres procédés restés secrets, les caractères matériels vraîment propres à l'œuvre et qu'il serait impossible à un copiste de reproduire, sont relevés pour constituer la fiche d'identité de l'œuvre comparable, en tous points, à la fiche de BERTILLON pour l'individu.

L'artiste ou le possesseur actuel de l'œuvre la vend-il, il cède, en même temps, son certificat (ou le duplicata qu'en délivrerait la Société, sur demande, avec un double des épreuves photographiques et radiographiques).

La comparaison de ces épreuves à l'œuvre en question permet à quiconque de s'assurer de son identité (voir à ce sujet la Notice spéciale).

La falsification est impossible.

Ou bien l'on présente une copie de l'œuvre avec le vrai certificat. Dans ce premier cas, une comparaison minutieuse suffit à dévoiler la supercherie

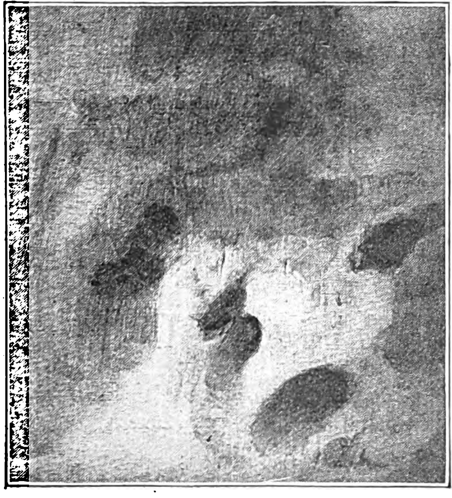
Ou bien, l'on présente un faux certificat fabriqué exprès pour la copie: Dans ce second cas, la comparaison de ce certificat avec les originaux conservés à la Société, sans que l'œuvre elle-même ait besoin d'être transportée, révèlera le faux et donnera aux ayants-droits le moyen de poursuivre, devant les Tribunaux, le faussaire, qui n'aura plus, dès lors, la faculté d'arguer de sa bonne foi

THE CERTIFICATE

A certificate is issued with each painting which is registered. A copy of this is given to the artist and is to accompany the painting at all times. The original of the certificate is then filed with other data, including photographic enlargements and X rays such as those shown herewith

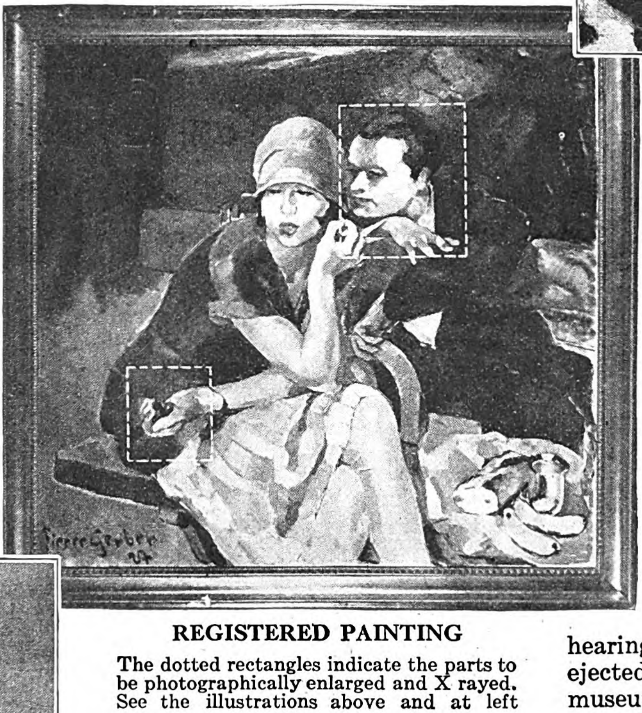
laboratories are called upon to furnish their proofs. Considering that these researches are the work of persons especially skilled in the field of scientific judicial research, it is evident that the resources of science should be applied in like manner to the protection of works of art.

The various persons who are interested in this field are artists, collectors of art works, directors of art galleries, art experts, antiquarians, dealers, and others. It is only reasonable that these interests, which often represent much capital and are often required to deal not only with questions of art but also with matters of great financial importance, should be able to avail themselves of the resources afforded by our skilled scientific experts. As will be seen, this will put the expert examination of works upon an entirely new basis in the future.



X RAYED

The lower rectangle in the center photograph, as revealed by the penetrating eye of the X ray. Note texture of the canvas

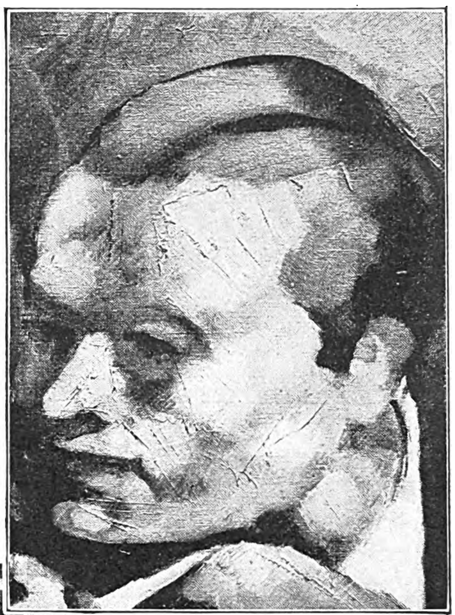


REGISTERED PAINTING

The dotted rectangles indicate the parts to be photographically enlarged and X rayed. See the illustrations above and at left

The methods employed have been largely referred to in the article entitled "Scientific Examination of Paintings," in the May, 1929 issue of the SCIENTIFIC AMERICAN. Referring to all these methods, it is evident that they will greatly increase the means at the disposal of the expert, for they will give him means which the unaided eye could not afford. However, a laboratory of this kind is necessarily incomplete, for other methods with their several types of apparatus will, of course, be brought out in the future for further applications of science to the examination of works of art.

In conclusion, it may be stated that the modern expert examination of paintings will bear upon the following points: Nature of the fiber of the canvas; Nature of the impurities contained in the canvas; Comparison of the canvas of two pictures; Nature of the wood panel and comparison of two panels; Tears and holes in the canvas and restored places; Coating on the canvas or panel; Mineral matter in such coatings, lime, lead, or others; General nature of the pigments, such as mineral colors, lakes, organic colors, or the like; Constituents of the colors; Comparison and identification of two colors; Picture repainted or made over (or changed in parts); Restorations; Picture painted underneath; Picture scraped or over-painted by another artist.

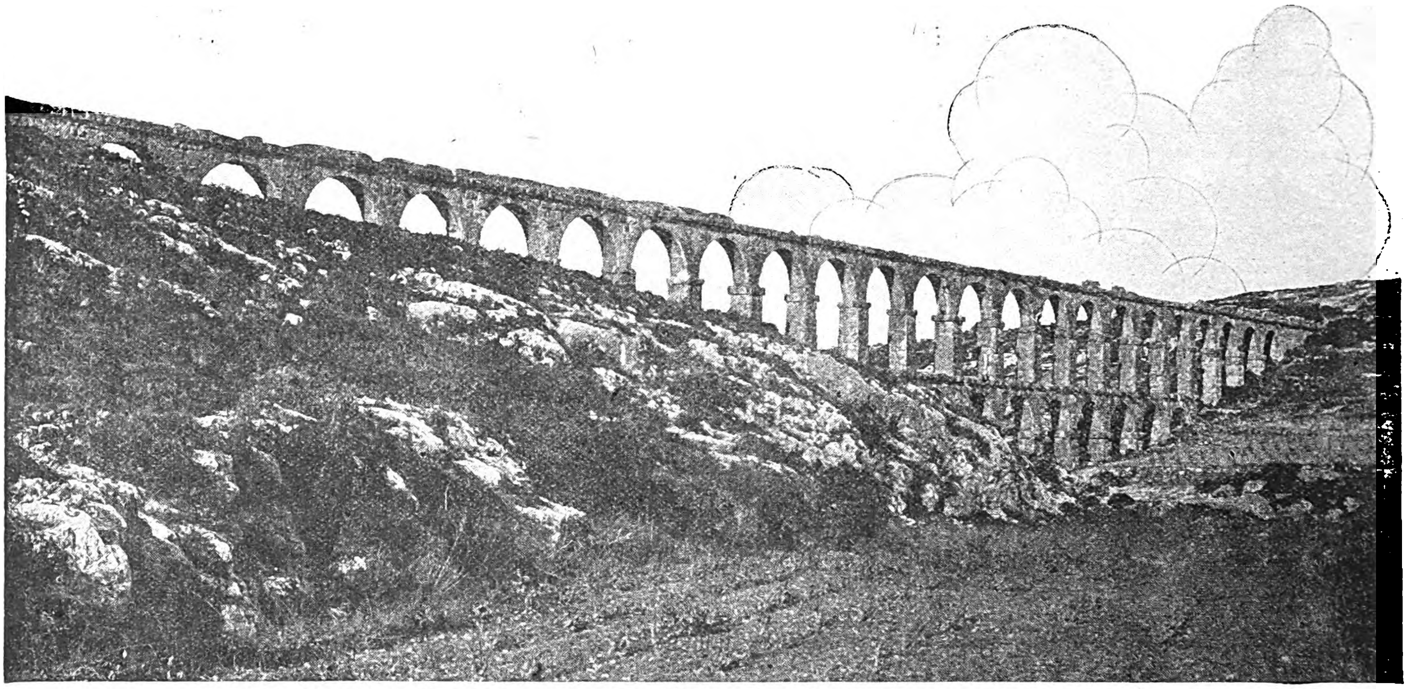


PHOTOGRAPHED

The upper rectangle in the illustration at the left, as it appears when it is photographically enlarged

This is an age of great suspicion and we are constantly hearing of spurious works of art being ejected from their high estate in museums or private collections. We must differentiate between the imitator or the copyist who frankly sells his wares as such, and the faker. Ethically, there is a strict line drawn between the imitator and the more or less artistic faker who is a forger with what we might call a "college education" in his particular line.

We are indebted for the above information to the Société du Droit d'Auteur aux Artistes, of which the leading spirits are its director, M. Georges Delavenne and its secretary, M. Duchemin; also M. Frantz-Jourdain, its president and the eminent chief of this modern art movement.



ROMAN AQUEDUCT AT TARRAGONE, SPAIN, AS IT APPEARS TODAY

With a history dating back to the days of Julius Caesar, Tarragone possesses this example of aqueduct construction. It is 22 miles long, partly underground. It was restored to use between 1780 and 1800. Other Roman aqueducts still carry water as of old

Roman Engineering Triumphs

Vast Systems of Aqueducts Built by Roman Emperors Have Commanded Much Admiration From Ancients and Moderns Alike

UPON the traveler whose imagination plays against a background of Roman history, the aqueducts of the Eternal City exercise a never-ending fascination. Those old Romans made both war and peace in an heroic manner. Their legions and their ships of offense moved with a conquering cadence while their architects and engineers thought and wrought in the scale of immortality. On the bloody sands of the Flavian Amphitheater the gladiators saluted Caesar with "Morituri, salutamus," but the Coliseum itself has always seemed to say, "Ave, Roma Immortalis." And the aqueducts, marching across the Campagna "to take part, by fountains, in this Roman triumph," seem to utter the same proud phrase.

In Rome, as in the empires that preceded Rome, tremendous expenditures of brain, time, and labor were made to solve the primary problem of water supply. But Rome, far more than the precedent empires, gave to water all that she could command of art in order that hydraulic engineering might be beautiful.

Roman architecture has been endlessly acclaimed, but Roman engineering has not always received its due. "In comparing Greek and Roman aqueducts," wrote Thomas Ashby, director of the British School of Archeology at Rome, "many writers have enlarged on the greatness of the latter as an example of Roman contempt for natural obstacles, or even of Roman ignorance of the laws of nature. Now, in the first place, the Romans were not unacquainted with the law that water finds its own level, and took full advantage of it in the construction of lofty fountains and the supplying of the upper floors of houses. That they built aqueducts across valleys in preference to carrying pipes underground was due simply to economy.

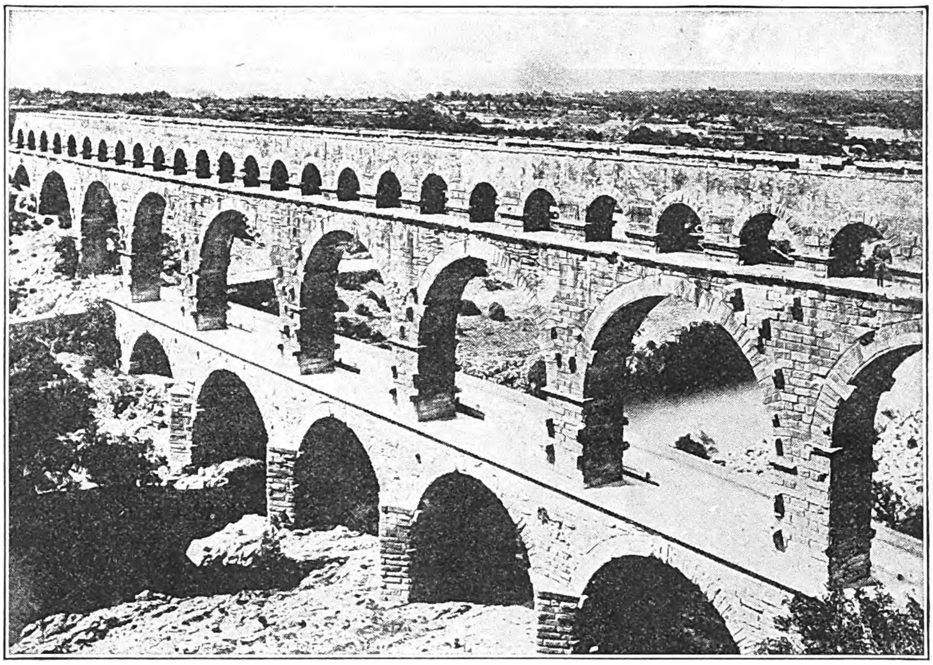
"PIPES had to be made of lead which was weak, or of bronze which was expensive; and the Romans were not sufficiently expert in the casting of large pipes which would stand a very great pressure to employ them for the whole course of a great aqueduct. Secondly, the water was so extremely hard that it was important that the channels should be readily accessible for repair as well as for the detection of leakage. Moreover, the Roman aqueducts did not, in fact, preserve a straight line regardless of the configuration of the country. A striking example is the aqueduct of Nemausus, the springs of which are some 10 miles from the town, although the actual distance traversed is about 25. Other devices, such as changing the level and then modifying the slope, and siphon arrangements of various kinds were adopted (as in the aqueduct of Aspendus)."

There were 11 aqueducts in use during the height of Rome's greatness. The water-carrying channels of these aqueducts varied a great deal in size at different points of the line. Anio Novus is the largest, being from three to four feet wide and nine feet high to the top of its pointed roof. They are lined with hard cement containing fragments of brick. Concerning their capacity, Mr. George E. Tonney, of the engineering department of Spring Valley Water Company of San Francisco writes:

"The discharge capacity of the total of these aqueducts is extremely problematical. Estimates and calculations made by different engineers vary from 60,000,000 to 400,000,000 gallons per 24 hours. Herschell, an American engineer, makes the estimate of 84,000,000 gallons, 54,000,000 used within the city and 30,000,000 without. He calculated that the Claudia and the Novus each could carry 16,800,000 gallons. The daily consumption in the city he put at 20,000,000 gallons, or 38 gallons per inhabitant."

"All the aqueducts," wrote Ashby, "ended in the city in huge *castella*, or reservoirs, for further distribution.

Vitruvius recommends the division of these into three parts—one for the supply of fountains, one for the public baths, and one for private consumers. . . . Besides these main *castella*, there were also many minor *castella* in various parts of the city for sub-distribution. To allow the water to purify itself before being distributed in the city, filtering and settling tanks (*piscinae limariae*) were built outside the walls. These *piscinae* were covered with vaulted roofs, and were sometimes on a very large scale, as in the example still preserved at Fermo, which consists of two stories, each having three oblong basins communicating with each other; or the *Piscina Mirabilis* at Baiae, which is covered by a vaulted roof, supported on 48 pillars, and perforated to permit the escape of foul air. Stairs lead to the bottom of the reservoir. In the middle of the basin is a sink to collect the deposits of the water. The walls and pillars are coated with a stucco so hard as to resist a tool."



PONT DU GARD, NIMES, FRANCE

A strikingly beautiful piece of Roman aqueduct architecture, in a fine state of preservation. For comparison of size, note the man standing on the second tier at the extreme right

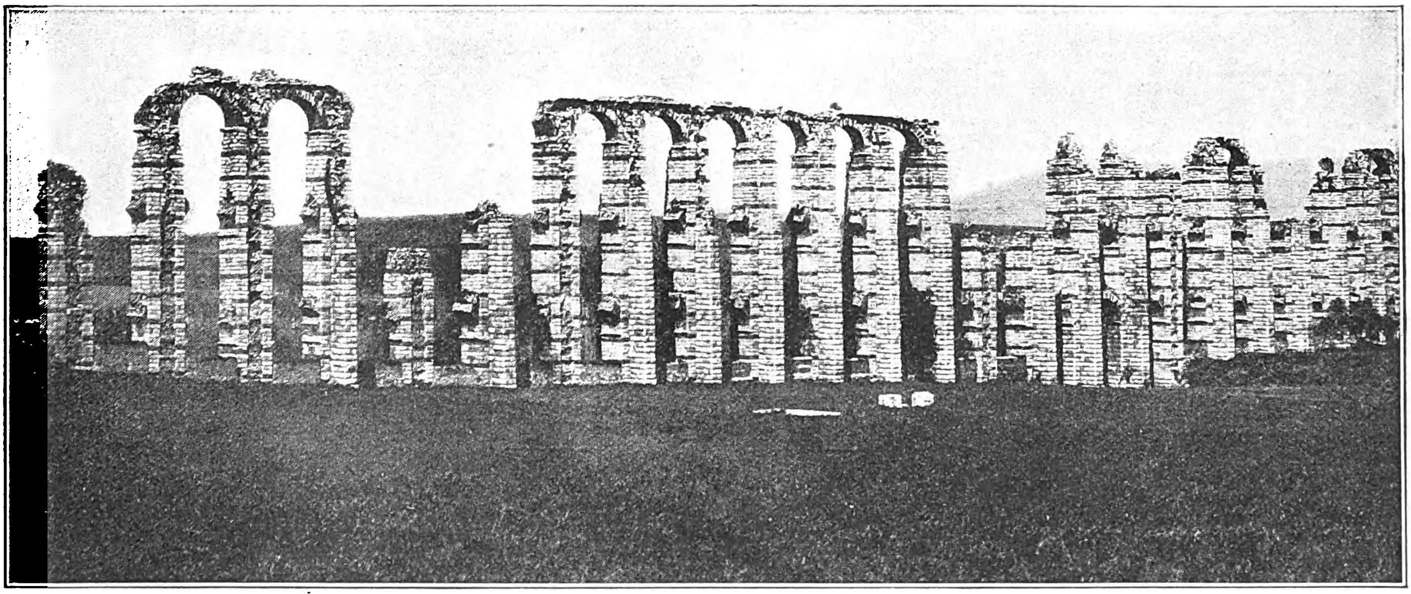
CONCERNING the materials used in the Roman aqueducts, and certain engineering features, William Matthews is our authority.

"The materials employed were different even in the same aqueduct; and in constructing an arch of the Aqua Marcia there were used three kinds of stone, one reddish, another brown, and a third of an earthy color. The Aqua Claudia was constructed with beautiful hewn stone, while others were built with bricks and a strong cement, which so firmly united them as to render the work almost a solid mass. Moreover, the Aqua Appia differed from the others, by having a peculiar construction of width as it approached the point where the water was disembogued for use in the city.

"Although several of the Roman aqueducts might have been constructed in a straight line, yet it is remarkable that their contrivers adopted a sinuous course with numerous windings. Various plausible reasons have been suggested for their preference of such a devious track, some presuming its chief object was to avoid the expense of erecting arcades of great height and solidity, while others have inferred that it solely had in view the preserving of a gentle and equable current for the water. The latter reason appears to be both plausible and cogent, for if the velocity had been considerable, the strong and impetuous motion of the water would have kept it in a turbid state continually, and consequently rendered it unsuitable for drinking purposes. However, another important circumstance demanded peculiar attention and consideration; this was the prevention of injury to the aqueducts from the constant irritation produced by the force and motion of a very quick current upon the bottoms and sides of their channels, for the repairing of such dilapidations would inevitably be attended with great inconvenience."

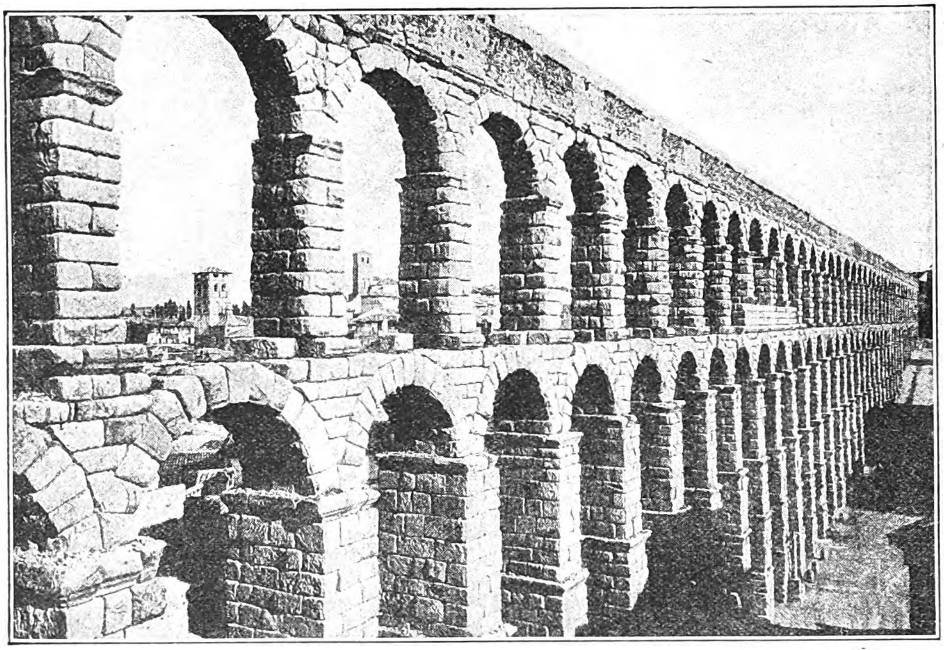
The Roman aqueducts did not have to wait until modern times to command admiration. Men who saw them building were deeply impressed. Thus, Pliny wrote:

"If any person shall very attentively consider the abundance of water con-



AQUEDUCT MERIDA AT MERIDA, SPAIN

Founded in 23 B.C., Merida flourished and came to be known as "the Spanish Rome." Its ruined aqueduct shows three tiers of arches, the abutments of which are visible here. The decorative effect was obtained by layers of bricks between granite blocks



THE FAMOUS ROMAN AQUEDUCT AT SEGOVIA, SPAIN

This structure dates from Augustus. It was partly destroyed several times and finally rebuilt by Isabella the Catholic in medieval times. It was built without mortar or clamps

veyed to the public, for baths, fishponds, private houses, fountains, gardens, villas, conducted over arches of considerable extent, through mountains perforated for the purpose, and even valleys filled up, he will be disposed to acknowledge that nothing was ever more wonderful in the world."

For Agrippa, who built Aqua Julia and Aqua Virgo, Pliny has a special admiration, stating that "in the course of one year he actually formed 70 pools, 105 fountains and 130 reservoirs, besides adorning all these works with several hundreds of marble statues and columns."

Modern scientists have been equally enthusiastic. Thus, Professor Leslie wrote in his "Elements of Natural Philosophy:" "These works were executed in the boldest manner; nothing could resist the skill and enterprise of the Romans; they drained whole lakes, drove mines through mountains, and raised up the level of valleys by accumulated arcades. The water was kept cool by covering it with vaults, which were often so spacious that, according to Procopious, who wrote in the time of Belisarius, a man on horseback could ride through them. So abundant indeed was the supply as to induce Strabo to say that whole rivers flowed through the streets of Rome."

Aqua Claudia, one of the most famous of ancient Rome's 11 aqueducts, was begun by the Emperior Caligula in 38 A.D. and completed by the Emperior Claudius in 52 A.D. Its farthest spring, the Fons Albudinus, was about 45 miles from Rome. It crossed ravines and tunneled hills until within seven miles of the city, entering upon a magnificient line of arches.

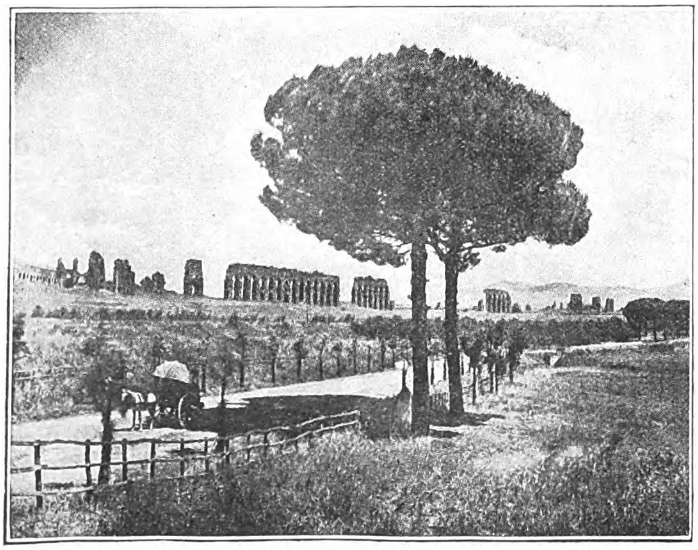
The ruins of Aqua Claudia form one of the most conspicious features of the Campagna. Although finished in 52 A.D., restorations and repairs were found necessary under Emperor Vespasian in 70 A.D. and Emperor Titus in 80 A.D. This surprising need is laid either to hasty or to dishonest construction—the inscriptions recording the fact are discreet.

The most important Roman aqueducts in Spain are those of Segovia, Tarragona, and Merida.

From its mountain sources the water destined for Segovia is carried part of the way in an uncovered conduit, then underground to a reservoir on a height above the city. Beyond this is the aqueduct proper, 2400 feet long, with 109 arches of fine masonry in two tiers, reaching the height of 102 feet.

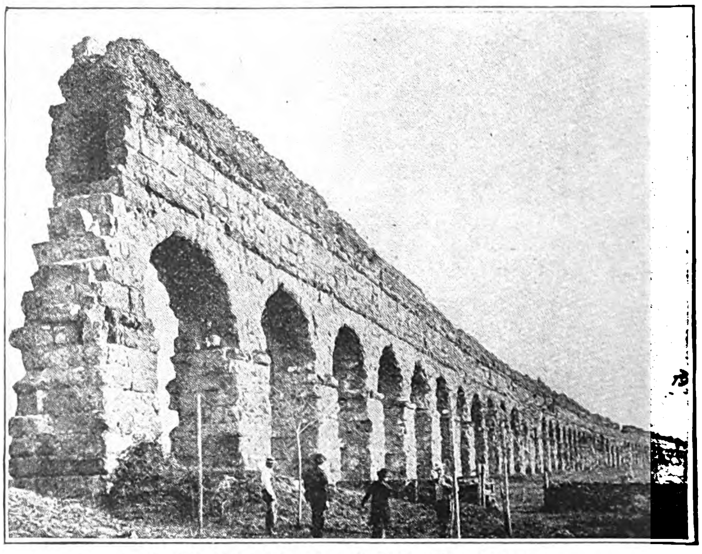
THE section of the Roman aqueduct at Segovia, at the left, called El Puente, traverses a deep valley, the suburbs, and part of the city. Dating from early Roman times, it was restored under the Flavians or Trajan. It was partly destroyed when the Moors beseiged Segovia in the 11th Century, but was rebuilt by Isabella the Catholic and dedicated to the Blessed Virgin and St. Sebastian.

Of this Segovian aqueduct, William Mathews wrote: "This fine structure is remarkable for its solidity and excellent masonry. Fortunately, this admirable relic of antiquity has withstood equally well the devastating violence of barbarians and the powerful attacks of inclement seasons, through a long series of ages. The design is strikingly light and beautiful; and its aspect has not only afforded gratification to architects but has also puzzled antiquarians who have entertained different opinions with regard to the epoch of its construction—some ascribing the merit of erecting it to Trajan, and others to Hercules, for it has no inscription to determine the period in which it was built."



THE BEST KNOWN OF THEM ALL

One of the most famous of the Roman aqueducts: the Aqua Claudia, which once stretched impressively across a wide valley



A CLOSE-UP OF AQUA CLAUDIA

The rugged construction of this great water-carrying "bridge" is clearly discernible in this illustration. Note tunnel channels

CIRRUS
ENGINES INC.

A TYPICAL LIGHT AIRPLANE

Lady Mary Heath in the rear cockpit of the type of airplane in which she made a solo flight from Capetown to London, a distance of 8000 miles. She also established a light-plane altitude record when she attained a height of over 18,000 feet

More Details About

Our Light-Airplane Design Contest

THAT this is the Airplane Era cannot in the least be doubted, for aside from the commercial activity with its many millions in consolidated interests, new airports are springing up everywhere under civic promotion, commercial necessity, and private enterprise—the latest of which is that of real estate developments using airports for promotion propaganda.

Our light-airplane design contest, conceived to stimulate interest and advance in private flying, was enthusiastically received when first announced, but no one connected therewith would have been bold enough to predict that within such a short time we would receive eighty entries; the number in hand as this is written.

As this is a contest based on points given for excellence in various stipulated essentials, we want to make it clear that should a tie result for the first prize, the committee will award the full amount of the prize to each individual so tieing for first place.

Quite a few questions have been asked by entrants to the contest and we answer them here as they may be of interest and value to some others who did not think to bring them up:

Q. What scale for drawings does the Committee favor?

A. Three view drawings should be to a scale of 1 inch to the foot, or better still 1½ inch to the foot. Layouts 1½ inch to the foot. Power plant and installation diagrams 1½ inch to the foot.

Q. How far off center is the crankshaft?

A. As the propeller is mounted on an extension of the crankshaft, the latter must necessarily be on center.

Q. What is the length of the propeller?

A. This varies with the pitch between 6 and 7 feet, the average being 6½ feet overall.

Q. What is the propeller rotation?

A. The rotation is clockwise as observed from the cockpit.

Q. To what extent do you require the investigation of "stress analysis" and preliminary performance calculations?

A. Wing stress analysis should be made for high and low incidence condition only. Fuselage analysis for high and low incidence condition and level landing condition. Chassis for level landing and three point condition. No other stress analysis need be carried out. Performance calculations need only be presented on the basis of accepted empirical formulae.

Q. Can groups of individuals such as flying schools or aeronautical engineering students submit a design for the group?

A. Yes, for such groups are not different in essential status from a company or corporation.

Q. Must the design submitted be for a single-motored plane?

A. Yes, the contest is restricted to a two-seated single-motored plane.

Q. Must the design be for a land plane?

A. The Committee places no restriction on the type of design except that the fuselage shall be of metal.

Q. Can more than one project be submitted?

A. There is no restriction as to the number of designs which can be submitted by an individual.

Q. Shall I submit a model of my design?

A. Models are not required, but the results of a tested model would materially aid the Committee.

Q. What are the Department of Commerce requirements?

A. These can be obtained from Bureau of Aeronautics, Department of Commerce, Washington. Submissions will not be received after August 15, 1929.

A FAMILIAR SIGHT IN THE SOUTH

Inadequately covered, loosely packed bales of ginned cotton are left outdoors exposed to the weather for months at a time due to lack of warehouse space. The staple deteriorates and much of it is torn from bales and wasted

Wasteful Cotton Baling Methods

Southern Farmers Retain Old Methods Despite the Fact That Much Waste Results. A More Efficient Method Exists and Is Slowly Coming Into Use

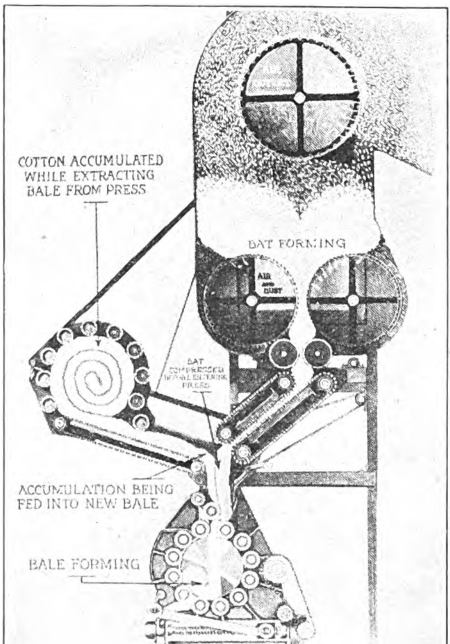
By H. D. MARTIN

THE South has always been "the land of cotton," but down through many generations there have been but few important changes in the methods of gathering and marketing the crop. It is gathered today by hand as it has always been. In an average crop of 15,000,000 bales, the human fingers must pluck from the open boll every fiber and seed and convey to bags 22,500,000,000 pounds within an average picking season of four months. Fortunes have been spent in efforts to produce a successful cotton picker, but thus far, there are none in commercial use.

COTTON was first packed and shipped to the mills of Lancashire in gunny sacks which were called "bags." When these were found too bulky in the hold of the sailing vessels, the "bale" was devised by packing in a box press, partly covering with heavy jute, and tieing with ropes. The single difference between the primitive bale and that of today is the substitution of iron bands, or ties, for the ropes.

The event that has had the greatest influence upon the cultivation of cotton was the invention of the cotton gin by a New England school teacher, Eli Whitney, in 1793, and it is interesting to note that the Whitney principle of separation of lint from seed by the saw gin is the one generally employed throughout the United States today. True, there have been improvements in present-day construction but these have been chiefly in the nature of refinements and labor-saving devices.

One other radical factor in the cotton industry was the introduction of the "compress," the purpose of which is to reduce in size, by hydraulic compression, the plantation bale as it comes from the gin. The function of this device is to economize space in transportation through gin compression. It was used widely during the World War, at a time when there was a great dearth of rolling stock and bottoms. And while today there is no such emergency to necessitate its use, it is none the less a sad commentary on our progressiveness that even the exigencies of war could not eradicate indefensibly wasteful methods.


COTTON ACCUMULATED WHILE EXTRACTING BALE FROM PRESS
BAT FORMING
AIR AND DUST
BAT COMPRESSED BEFORE ENTERING PRESS
ACCUMULATION BEING FED INTO NEW BALE
BALE FORMING

THE ROUNDBALE PRESS

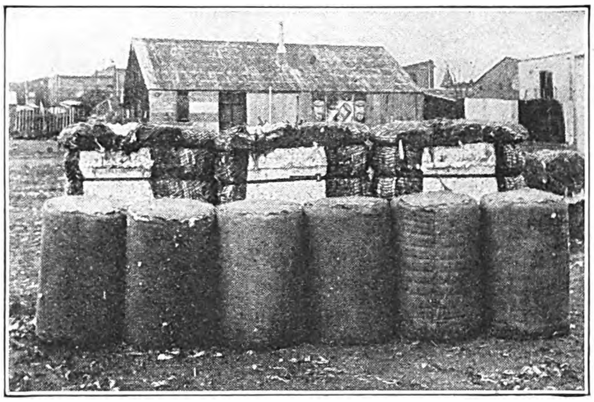
This machine packs cotton into high-density, convenient-sized rolls. The resulting "bale" is completely covered with burlap

THERE are two phases of this great anomoly, one being transportation and the other, the form of the commodity and the way in which it is handled. Under existing methods the farmer brings his seed cotton to the nearest gin, where the lint is baled in what is called the "plantation bale," weighing about 500 pounds and with a density of about 12 pounds to the cubic foot. Thirty three of these are loaded in the average freight car and in 100-bale lots shipped to the nearest compress. There it is unloaded while the cars remain idle and the bales are compressed to a density of 22 pounds to the cubic foot. The hundred bales are then loaded in two cars and shipped to their destination. If they are destined for shipment abroad, then before being loaded on a vessel and in order further to reduce the size to a density of 32 pounds per cubic foot, they are again subjected to compression in what is called a high-density press. An ocean freight differential makes this last operation profitable. It is not difficult to conceive of the enormous cost of thus frequently handling a bulky commodity weighing a quarter of a ton, in addition to the loss of time in transportation and rolling stock.

The other wanton economic waste is in the form and system of handling the crop under existing conditions. It will no doubt surprise those who boast of our progressive methods to learn that even countries like India and China are far ahead of us in some respects in the handling of a cotton crop.

As is readily seen from our illustrations, the American bale is only partly covered by a coarse jute covering, which affords but little protection and adds greatly to the weight. By reason of the fact that about 90 percent of our crop is gathered in a limited area in four months, and in the absence of adequate warehouse protection, it is a common sight to see hundreds of bales lying out in the mud and exposed to wind and weather until ready for shipment. The result is what is known in the trade as "country damage," and this hazard is regularly provided for in insurance policies.

Since cotton fiber is highly absorbent, it holds much water which cakes and disintegrates the staple until often as much as a third of a bale is ruined. The hazard from fire is greater than it is in a less exposed and more compact bale and the insurance, as well as the marine rate, is correspondingly higher. No doubt sparks generated by the striking of iron ties against one another in the hold of a vessel have been responsible for many fires at sea. Incidentally, since these ties weigh 25 pounds per bale, they constitute an additional expense in transportation as well as in cost. Another source of loss from the present system is that a portion of each cargo reaching a foreign port is designated in the trade as "no marks," that is, bales from which the marks have been blurred so as to render identification impossible and ownership doubtful. These bales are apportioned among the consignees of the shipment regardless of value.



A STRIKING COMPARISON

Three unwieldy plantation bales compared with six roundbales containing the same amount of cotton

OLD BLACK JOE

A factor in cotton production that cannot be eliminated: hand labor in the fields

To the layman the question arises: "Why has not some of the inventive talent of the United States devised methods to do away with this seemingly preventable loss, by compressing cotton at the gin?" A few years ago a determined effort was made to introduce gin compression of square bales—that is, a bale of the usual shape and weight but compressed at the gin to a density equal to the "high density" compressed bales. These were adequately covered to prevent loss from damage, theft, and also to reduce the fire hazard to some extent. They were a marked improvement over the present system, as pointed out by the Department of Commerce pamphlet: "Packing and Marketing of Cotton." It is believed that none of these presses is now in operation, possibly for the reason that the reform did not go to the full extent necessary to correct all of the abuses of the existing conditions.

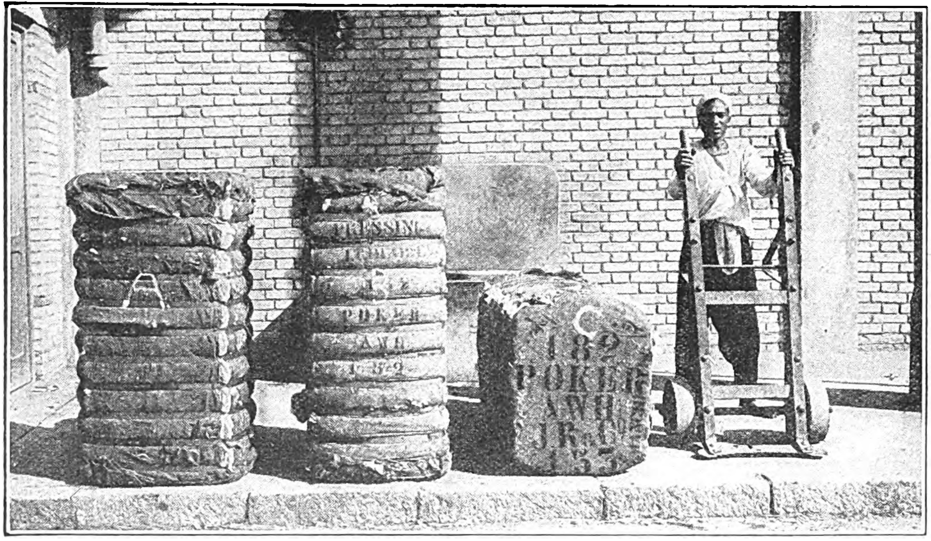
More than a generation ago, inventors had succeeded in producing a revolutionary type of bale which, for want of a better name, was called a "roundbale." It was cylindrical in shape and was made by forming the lint cotton into a "bat," or batting. This was run through heavy iron rollers so that the air was gradually expelled. By this method, a density of about 32 pounds to the cubic foot was obtained, a density equal to the best obtainable with hydraulic presses. Passing the staple through the rollers had the advantage of smoothing and straightening the fiber in contrast to the effect of the sudden stroke of the powerful hydraulic press.

The bale was made by winding the bat like a roll of carpet and since the air had been gradually expressed, there was no need of iron ties. Therefore the bale was completely covered by a closely woven burlap, ready for shipment by rail or steamer direct to its destination. This burlap covering constitutes a tare of 1 percent—or five pounds to 500 pounds of lint (that is, two round bales)—whereas the bale of commerce has 6 percent tare and is sold on that basis—or 30 pounds to 500 pounds of lint. This saving in the cost of the bagging and ties and the freight thereon is enormous.

In brief, the system had so many advantages that in 1897, Mr. John E. Searles, one of the most successful financiers of his day, with a group of associates, organized The American Cotton Company. All of the several roundbale interests were consolidated in this organization, and their first step was to employ the best available engineering talent to perfect a roundbale press by selecting the best features from existing inventions and eliminating some of the me-

ON THE SHIPPING PLATFORM

Bales, bursting of their own pressure despite heavy iron ties, ready to be shipped. Transportation cost on these is very high because so few of these bulky bales can be loaded into an ordinary freight car



THE SUPERIOR ORIENTAL BALE

In India, China, and Egypt, cotton is compressed into more compact bales than in America, and is thoroughly covered. Waste is negligible, freight costs are low, and markings legible

chanical defects such as are incidental to all inventions in their early stages of development.

The result was a package so fundamentally superior in every way to the square bales that within a few years the company was producing over 900,000 roundbales a year. Not only were the spinners here and abroad enthusiastic over its success but fire and marine underwriters and practically every disinterested factor in the cotton industry gave their heartiest support to the movement. One radical change in the roundbale itself was in size and weight. It was originally 48 inches long and weighed about 400 pounds, but the spinners suggested that a bale 35 inches long could be readily unwound by a simple mechanism directly into their mixers.

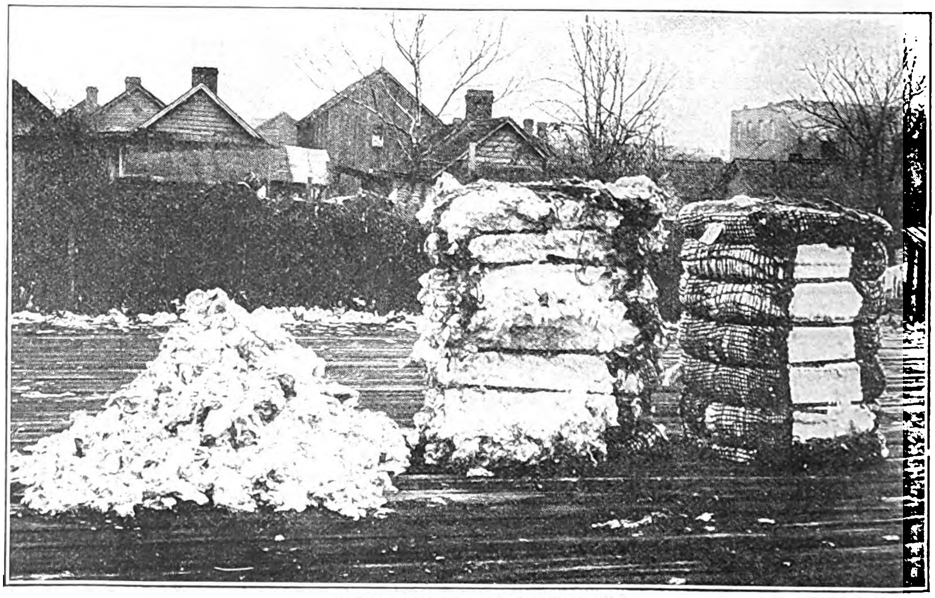
This recommendation resulted in the production of a bale of about 250 pounds which was easier to handle and constituted, for transportation purposes, an ideal package. Since then, all roundbales are of that standard size and weight and are classified in Government statistics as "half bales." It then seemed that the metamorphosis was complete all along the line and, with gin compression an accomplished fact, there would never be another hydraulic compress constructed. "Density compression at the gins would save hundreds of millions a year," said an authority several years ago, "hundreds of millions that now go for rehandling, extra haulage, needless space taken up on steamships and railroads, loss in transit, claims for damage, and for other items."

Then began a titanic struggle for supremacy. With perhaps 100,000,000 dollars invested in compress property, the owners were not altruistic enough to sit idly by and see their property become worthless. At that time the influence of the railroads was, for two reasons, thrown into the fight on the side of the compress interests. Many of the railroads held large blocks of compress stock, and furthermore their chief shippers were cotton firms who owned the compresses. Their chief weapon was the argument that The American Cotton Company was a gigantic trust—this at a time when politicians were making political capital by advocating the free coinage of silver and fighting the "money devil of Wall Street." They convinced those who were being benefited the most that, under the guise of correcting the many abuses in the cotton industry, the real purpose of the proponents of the roundbale was to control and monopolize the cotton crop through ownership of all roundbale patents.

The fight has even been carried to Congress. A few years ago Senator Ransdell of Louisiana introduced the following bill: "That the interstate Commerce Commission shall establish and enforce preferential rates on shipments of cotton based upon the cubic contents of the bale. In reaching its decision the Commission shall take into consideration the density of the bale, the amount of space it occupies, its uniformity in size, the character of its covering as a safeguard against damage or fire, and any other points that seem fairly to entitle it to favorable discrimination." The bill would have had the effect of favoring roundbale compression through preferential rates. This bill was never passed, but with its important bearing on lower freight rates and farm relief, it will, more than likely, receive favorable consideration at some future session.

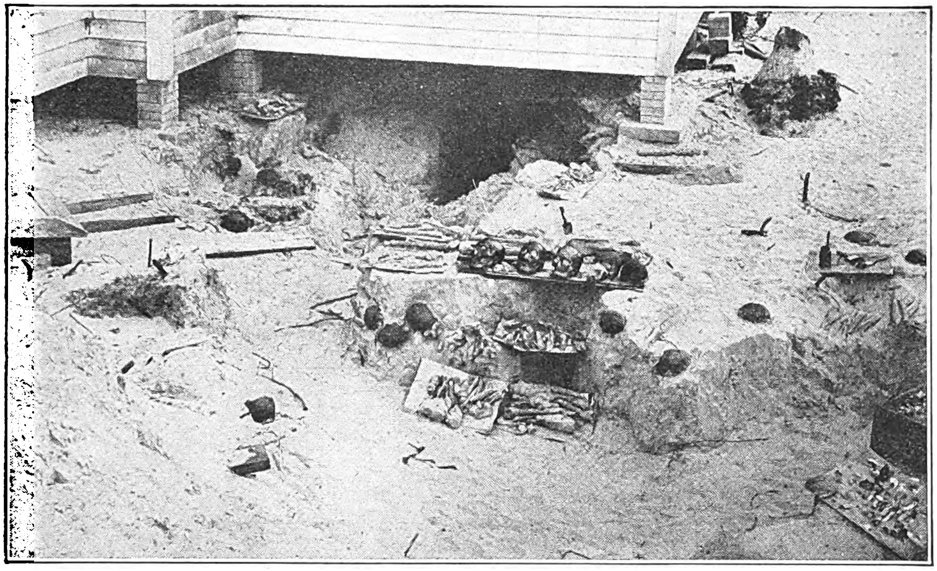
Thus it was that the compress won the fight and Mr. Searles' organization went into bankruptcy. For a time it seemed to the friends of the South that there was no hope of any further attempts to bring about these much needed reforms. In recent years, however, others have taken up the battle for gin compression, and have met with considerable success. There are now three distinctive types of roundbale compresses in use, one firm operating 260 presses. Although the entire roundbale output is less than 3 percent of the total American crop, the roundbale system is making marked progress each season, purely on its intrinsic merit.

Thus the situation stands. So long as a larger portion of this inexcusable waste is eliminated each year by the extension of a system that has everything to recommend it, the day is not far distant when the blot on the fair escutcheon of the South will have been entirely wiped out.



A SHAMEFUL CONDITION

An example of the inefficient method of baling cotton generally used in the South today. In the staple that has been pulled from the bale may be seen much that is badly soiled



SITE OF THE EXCAVATION

This photograph shows in a striking manner the spot where evidences of early Indians of Florida were found. Many of the skulls and bones so far dug up are displayed here

Early Indians of Florida

A FIND of great interest which is unique in some respects has been made by George Henriquez while digging beside his house near Tampa, Florida.

Up to the end of January, 133 skeletons had been unearthed. The skulls and bones of these show many different types: some have flat heads with no foreheads, the top structure extending back from immediately above the eyes like apes; others are nearly an inch thick, while still others extend up to a peak on top. Several sutureless skulls show that a number of this race lived to advanced age.

The most unusual part of the find, however, is the skulls with short bony protuberances at the base of the skull, probably an exceptional development of the styloid process which developed into a part of the skull bone.

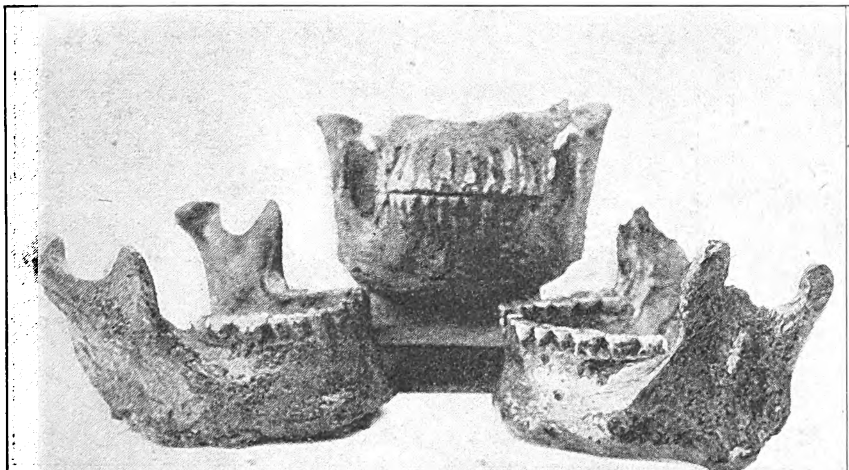
THE teeth and jaws are massive and strong and in all the specimens unearthed there has been found not one decayed tooth. In fact the front teeth resemble our double teeth; some even being turned edge forward. This is undoubtedly accounted for by the fact that they lived on natural coarse food, corn, fruits, berries, roots, et cetera.

The burial method is interesting. Most of those buried in the circles are in a reclining position; some have extremities doubled up to the trunks, others are curled up on their sides, while still others have the heads separated from the bodies, some six or eight heads being buried together and the bones doubled up and laid to one side like a bundle of sticks, this being a later burial than the first, probably a transferal from some other spot after an epidemic or calamity. In each case a conch shell perforated by a large hole is placed over the head at burial. Contiguous beds of charcoal indicate that ceremonial rites of fire were part of the burial ceremony.

Beads and ornaments made of shell, bone, horn, stone, and iron have been found with the remains of the women and children. Also pottery with many curious, unique, and interesting designs and inscriptions, circles with crosses in the center, circles blended together, and spirals. Others have triangular designs, snake designs, check designs and a design showing a man's head with beard, beak nose, and features which suggest a possible Mayan influence.

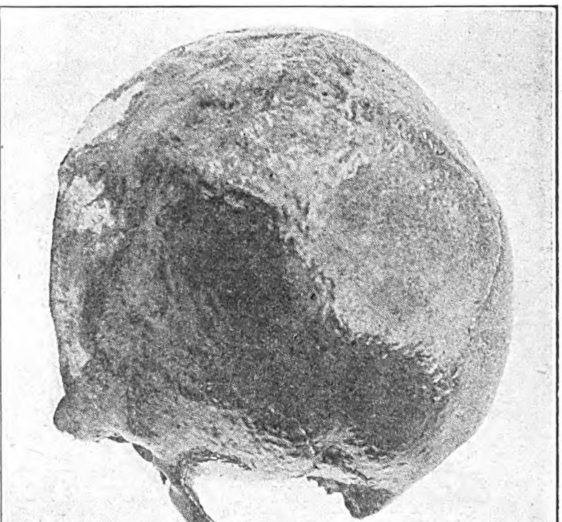
UNDOUBTEDLY this latest find belongs to the epoch of the other Tampa Bay mounds which, according to the Smithsonian Institution, probably range in age from 300 to 800 years, so no very remote antiquity can be assigned to them. They are the product of the Calusa and Timucua Indians who occupied them at the time Florida was first visited by Europeans, but archeological evidence indicates that some of the sites had accumulated a few centuries earlier.

Fortunately for archeology Mr. J. J. Hall, Secretary of the Florida Archeological Society, to whom we are indebted for the information about this find, is in active touch with the progress of excavation, so that all important features of the development will be preserved. If funds are forthcoming it is proposed to move Mr. Henriquez's house and proceed with the research.



LARGE TEETH, MASSIVE JAWS

In all the specimens located up to the time of writing, not a single decayed tooth was found. Note the broad grinding surfaces of the teeth, especially the front ones

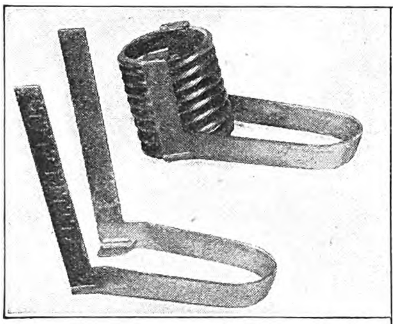


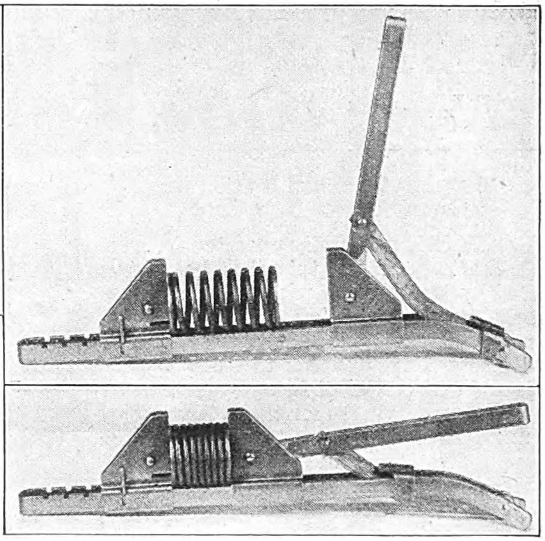
HORNS?

This view shows a bony projection extending one and one half inches from the base of the skull

KITCHEN CABINET

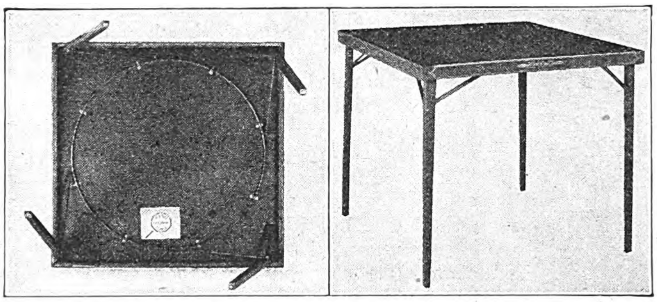
In the modern apartment or home, these new steel kitchen cabinets take the place of the old-fashioned pantry and cupboard. The new arrangement saves time, space, and materials. A single turn of a handle releases the desired amount of sugar, flour, or spice without exposing the contents. — *Maxwell Burke, Inc., Builders Building, Chicago, Illinois*





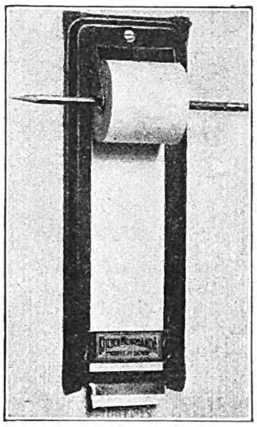
SPRING COMPRESSOR

Valve grinding is facilitated by the use of this tool, which compresses the springs and clips them together while they are tightly compressed. The clip is shown above, before and after it is attached to the spring. At **the right, above, the spring and retaining washer are ready to be compressed. While the spring is compressed, the clip is measured, bent, and fastened to the spring. A centering device properly places the clip on the spring. While thus held, the spring is placed in the motor and the clip is jerked off, leaving the spring in place.—*Sunnen Products Company, 6500 Manchester Ave., St. Louis, Mo.***



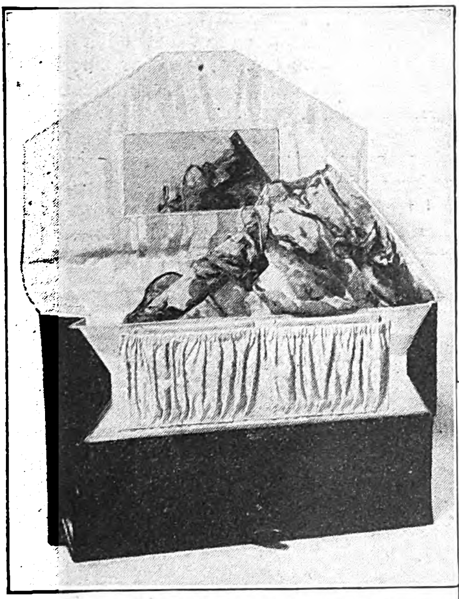
CARD TABLE FOLDS WITH ONE OPERATION

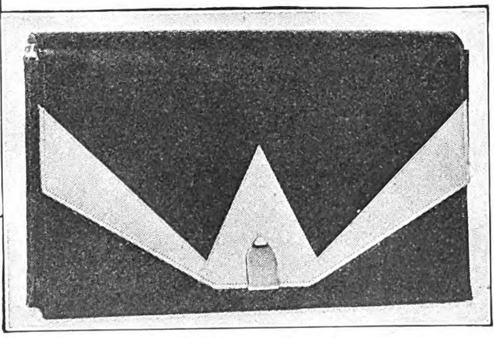
This folding bridge table can be opened or folded with just one operation. When the patented catch is released, the slightest movement of one leg causes the others to automatically follow suit. When the table is opened for use, the legs are securely locked, providing unusual rigidity and strength. The top of the table is also strengthened by the metal ring that supports the legs.—*Willett Manufacturing Company, Dayton, Ohio*



MEMO

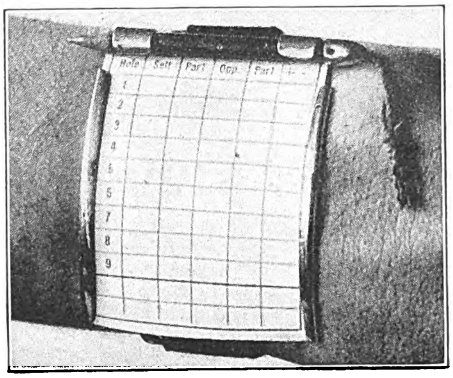
When fastened to the wall in the kitchen, this device provides the necessary pencil and paper for jotting down memoranda.—*Burgess Manufacturing Company, Beaver Falls, Pa.*





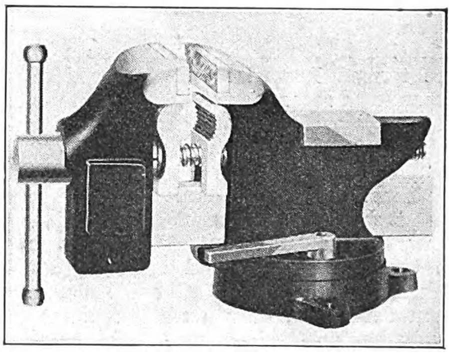
WARDROBE HAND BAG ▲➤

An evening dress, pajamas, handkerchiefs, toilet articles, and whatever else milady may need for an over-night stay, can be carried in this hand bag. A reel provides a means of folding the dress in order that it will not wrinkle while being carried.—*W. W. Winship, 71 Summer Street, Boston, Mass.*



SCORE RECORDER ➤

Fastening on the wrist like a wristwatch, this silver golf score device enables a player to keep an accurate record of his strokes by holes. A pencil is carried as part of the device. A pocket at the back provides a place to carry paper money.—*T. W. Foster Company, P.O. Box 1415, Providence, R. I.*



MIDGET VISE

A small vise with the quality of an expensive machinist's vise is now available, with swivel base, cold rolled steel screw and handle, permanently locked collar to prevent slipping, replaceable hardened tool-steel jaw-faces, removable pipe jaws, and a husky anvil back. The new models are made in three, three and one half, and four inch sizes.—*Columbian Vise Co., Cleveland, Ohio*

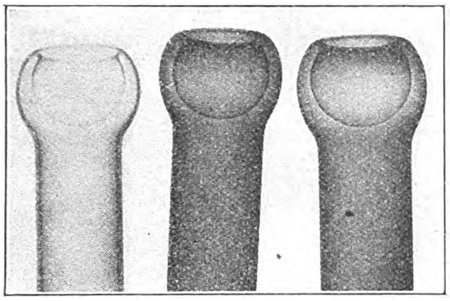
The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

Simplified Lenard Ray Tube Gives Science New Tool

A SIMPLE and easily operated form of the Lenard ray tube has been perfected by Dr. C. M. Slack, of the Research Department of the Westinghouse Lamp Company, Bloomfield, New Jersey, and in order to enable scientists to study the remarkable properties of Lenard rays and to develop practical uses for them, if possible, a number of these new tubes have been presented to chemical, physical, and medical laboratories in various parts of the country.

"The Lenard ray tube can best be described by comparing it to the X-ray tube," said Dr. Harvey C. Rentschler, Director of Research of the Westinghouse Lamp Company. "In the X-ray tube, cathode rays (which are streams of electrons) are developed electrically and are directed against a metallic target. This target, energized by the cathode rays, gives off X rays. Lenard's invention consisted in removing the target from an X-ray tube and placing a thin metallic 'window' at one end of the tube against which the cathode rays were directed. He found that, when sufficiently high voltages were employed, the cathode rays themselves could be driven through this window, thus making possible their application in innumerable ways; such rays are termed Lenard rays. Since X rays represent a secondary effect of the cathode rays, it is evident that Lenard rays themselves must be immensely more powerful.



With walls half the thickness of cigarette paper, these windows of the new Lenard ray tubes had to be photographed by means of the X ray to render them visible

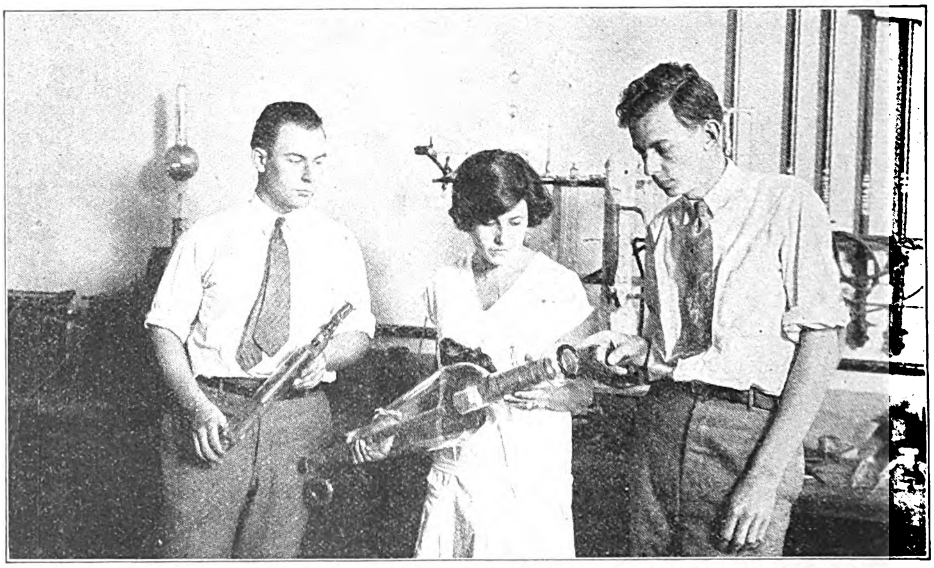
"Ever since this kind of tube was devised by Lenard in 1894, scientists have known that it was an instrument of extraordinary powers," states Dr. Rentschler, "but owing to the complication and operating difficulties of such forms as have heretofore been developed, only a small amount of study has so far been made. Dr. Slack, however, has produced a Lenard ray tube that is simpler than the ordinary X-ray tube—perhaps it can be fairly compared to an electric lamp or radio tube—and that can be operated by anyone of scientific training with the aid of apparatus to be found in almost every well equipped laboratory. He has, therefore, made Lenard rays available to general scientific research.

"The chief difficulty with Lenard's tube and later models based on it is the metallic window. The use of this window involves numerous operating complications, including the necessity of employing voltages of over 100,000, liquid air, or a continuously-operating vacuum pump. Dr. Slack's improvement consists in substituting a glass window for the metallic one, which enables us to make tubes having a permanent vacuum, thereby eliminating the need of all extraneous apparatus, except an ordinary X-ray outfit for producing the current for operating the tube.

"Dr. Slack uses a window of less than one two-thousandths of an inch in thickness, which is about half the thickness of ordinary cigarette paper, and this is more transparent to the rays than are the metal foils heretofore used. So thin is this window, that the slightest touch may destroy it, and yet, owing to the form Dr. Slack has employed, it withstands handling and transportation, and does not rupture even though it has to carry full atmospheric pressure due to the vacuum behind it.

'This window is formed by first blowing a bulb at the end of a glass tube of special composition. A section near the end of the bulb is then heated to a very high temperature, and, at the proper moment, the glass blower sucks into the tube, thereby drawing back into the bulb an extremely thin-walled spherical bubble of glass. The bulb, with its external bubble, is then mounted on the end of a larger tube containing electron-producing electrodes, the air is pumped out, and the tube is sealed up. The making of the windows requires the highest degree of skill and experience, but an expert can turn out hundreds of them a day.

"We know little about the properties of Lenard rays except that they are capable of causing remarkable and mysterious physical, chemical, and physiological changes, such as causing minerals to glow, changing gases into solids of unknown constitution, and destroying the life of animal and vegetable cells," said Dr. Rentschler. "X rays, also an unknown quantity at one time, have been of immense benefit to humanity and, since Lenard rays probably possess greater power, they may prove even more useful. Through Dr. Slack's accomplishment, science has been given a new and convenient tool of immense possibilities."



The laboratory worker at the right is pointing to the bubble window of the new Lenard ray tube, for which it is expected that many uses will be found

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"Squirting" Cold Copper Into Tubes

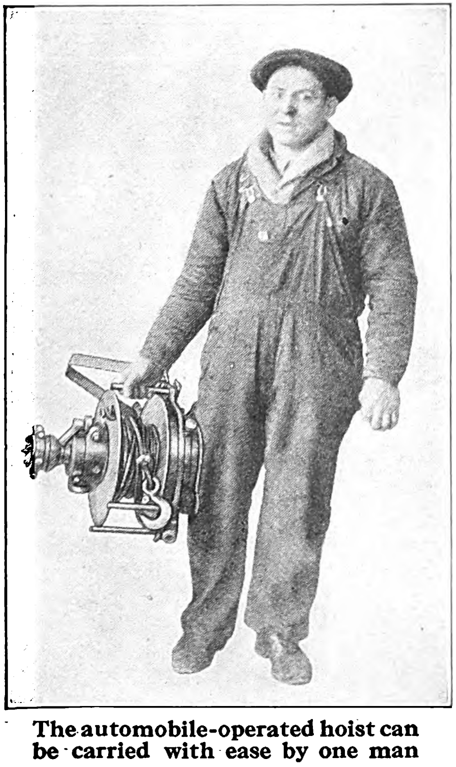
THE Winchester Repeating Arms Company of New Haven, Connecticut, is carrying on a unique and very interesting process of metal working at the present time. This process is known as the cold extrusion method of manufacturing seamless copper tubes. The application of these tubes is rapidly becoming familiar to the public through their increasing use in radiators for automobiles and airplanes and in the heat transfer elements of several unit heating systems.

The essential principle of extrusion is exemplified in the manufacture of macaroni—that is, a plastic material is forced under pressure through an annular or ring-shaped mold, making a seamless hollow tube. This same sort of extrusion has been in use in manufacturing lead pipes since 1850, and in a modified form, in making collapsible tube containers for shaving cream and for numerous other toilet preparations.

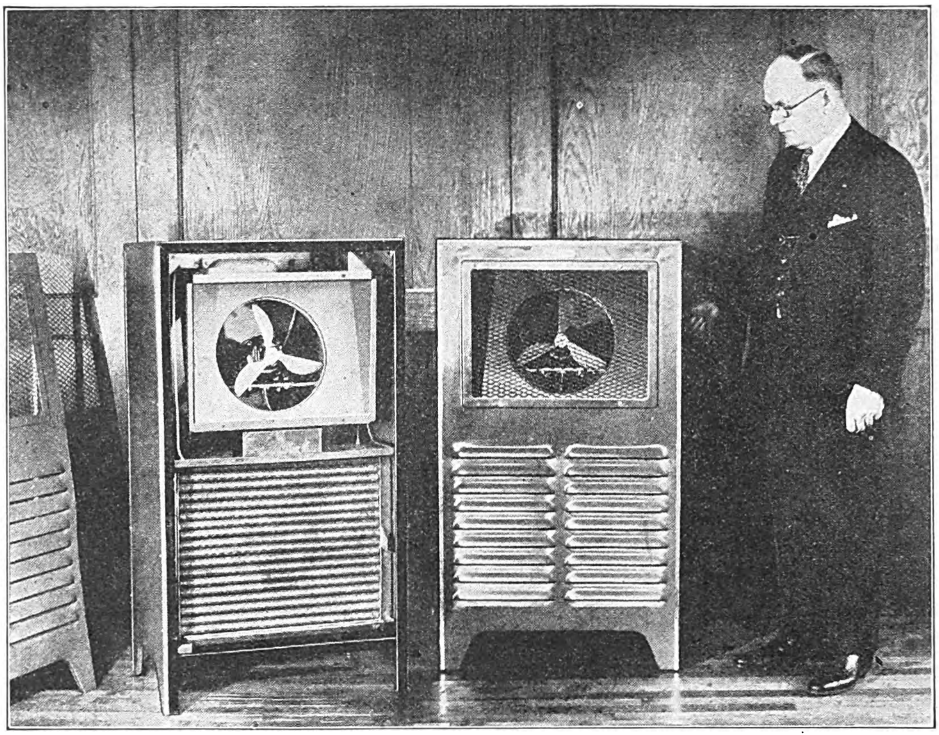
The newer application of the extrusion principle, however, does not deal with such soft substances as dough, lead, or tin, but with highly purified copper. It is of course known that even copper and other similar non-ferrous metals have been and are continuing to be extruded in various forms, but always in a heated state; that is, the metal to be extruded is heated almost to its melting point, and is then extruded, this high temperature making the metal very plastic and therefore, relatively easy to extrude. The method used in the new process, however, is to extrude copper without any preliminary heating whatsoever.

The high pressure required to make the copper flow through a die as a plastic material offers a mechanical problem, the solution of which has required a great deal of ingenious experimenting and development. The pressures to which the punches and dies are subjected in the process are nearly equal to the yield point of the steel. For this reason any factors in the operation which could cause a slight increase in the extrusion pressure, result in tool breakage. In a like manner any tool whose strength is slightly below specification due to faulty material, heat treatment, or workmanship will not stand up at all under the terrific punishment. In order to obtain satisfactory tools, a great many steels of different analysis and different methods of heat treatment had to be tried, and at present the quality of the tools must be rigidly maintained.

The procedure is briefly as follows: Copper rods approximately one half inch in diameter and of a purity of at least 99.90 percent are cut up in a shearing machine to form small cylinders seven sixteenths of an inch long. These are pierced along their axes in two successive punching operations forming cylindrical cups with walls one tenth of an inch in thickness and with a bottom of tissue-paper thinness. These cylinders or cups then reach the extrusion press where each cup is in turn enclosed in a hard steel ring and pressed downward by a punch against the die at the bottom. The machine applies a pressure of approximately 50,000 pounds on the copper cup and the only place for the metal to go is downwards through the narrow ring-shaped opening between the punch and the sides of the die. For an instant, the copper resists the pressure applied by the press and then literally squirts through the opening to emerge as a seamless tube about 11 inches long. This process can be better visualized when it is pictured that the extrusion presses have a stroke of about two inches and that the work emerges 11 inches long, all of the extrusion being done in one fifteenth of a second actual time. The wall thickness depends upon the size of the opening and is very accurately controlled. Tubes varying in thickness from .0035 inch to .0010 inch are made in this manner.



The automobile-operated hoist can be carried with ease by one man



Mr. L. S. Keilholtz, chief engineer of the Frigidaire Corporation, with two of the new room coolers, one of which is opened to show its interior mechanism

The immediate importance of this process depends upon the demand for the above types of tubing. Its principle use so far has been in the manufacture of heat interchangers such as radiators for automobiles and airplanes, steam radiators for forced draft unit heaters, and condensers for refrigerating machines and for steam engines. Lately a successful experimental fire-tube hot-water boiler, which looks extremely promising, has been made from these seamless extruded copper tubes.

Refrigerated Air for Homes and Offices

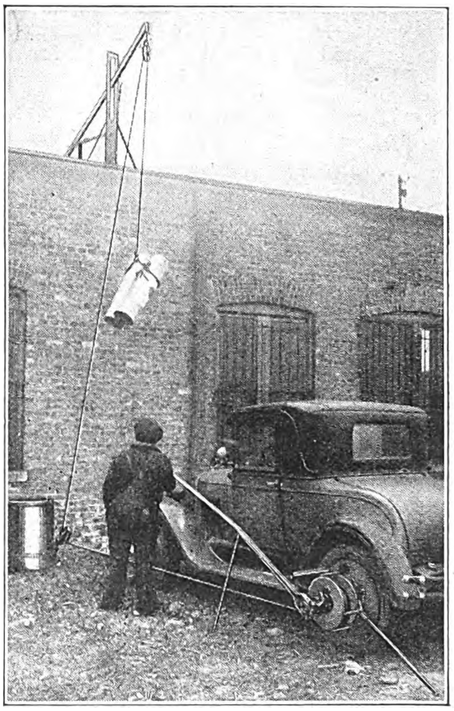
AN ELECTRIC room cooler, designed by Frigidaire Corporation for use in homes and offices, science's latest conquest over the discomforts of nature, has just been announced. In experimental tests, this cooler lowered the temperature of an average size room as much as 10 degrees in 30 minutes and brought about a 10 percent reduction in humidity.

When the cooler is in operation, the air passes into it through louvres in the front panel of the cabinet and through the bottom. This air is passed over cooling coils, and a fan with a capacity of 450 cubic feet a minute distributes the cold air into the room. The fan can be used alone like an ordinary electric fan.

The room cooler stands approximately four feet high and weighs 210 pounds.

Hoist Operated by Automobile

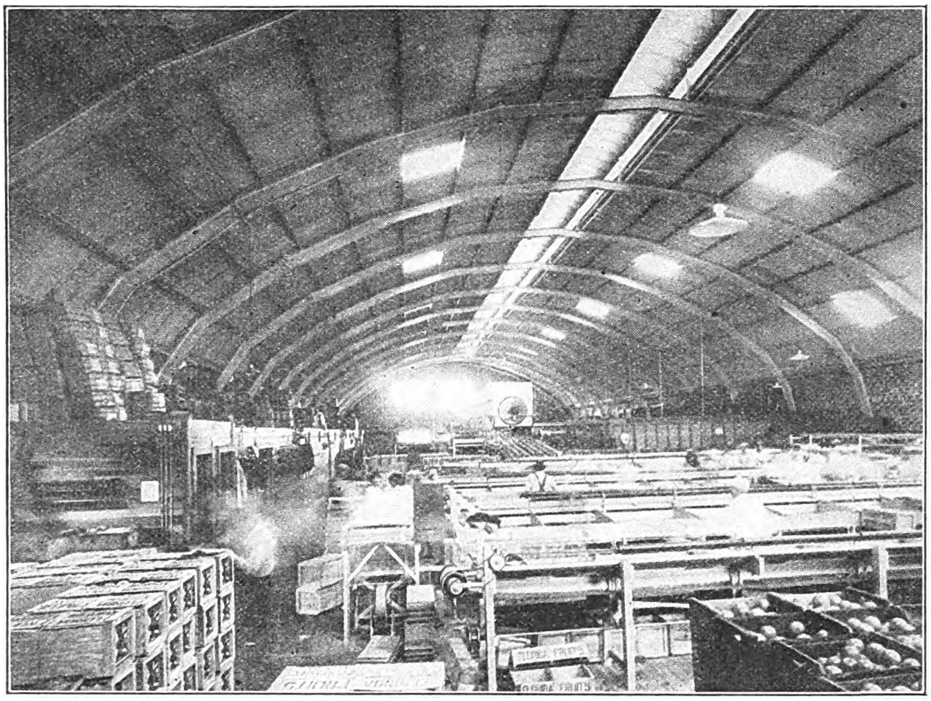
FOR roofers, steamfitters, plumbers, plasterers, building contractors, or anyone who has hoisting to do and runs a truck or car, a new hoist has been announced by the Moore-Master Manufacturing Company of Chicago. This hoist, which weighs about 88 pounds exclusive of the cable, is designed to be attached to the hub of the left rear wheel of any automobile or truck, the vehicle motor supplying the power.



The hoist, attached to the rear hub of an automobile, is fully controlled by a lever operated by a workman

The Master hoist is a cable drum with brake and clutch. It is attached to a ring which has previously been attached permanently to the vehicle hub by means of U-bolts. It may be used on any type of car, and any number of cars may be equipped with attachment rings so that, if one car of a fleet is in use elsewhere, another car may be used for the hoisting.

One lever operates the hoist. With the car motor running and the wheel jacked up, the operator throws in the clutch by a movement of the lever, the load is hoisted, braked at the proper time for emptying, and then is lowered away, empty, by leaving the device in neutral. The clutch and brake are so designed that they cannot be engaged simultaneously.


Hurricanes failed to distort the structure of this arc-welded building in Florida. Note the absence of columns and the lightness of construction

The capacity of this hoist is 600 pounds. The drum will wind 600 feet of one quarter inch cable—enough for a 24-story building. Two hundred feet of cable is enough for a building up to five stories in height.

Hurricanes Fail to Damage Arc-welded Packing House

IN central Florida there have been erected recently 15 buildings of arc-welded steel construction. Most of these are citrus packing houses, scattered throughout the fruit growing districts. The frames of these structures are all of the clear-span welded steel arch type, designed and erected by The Arch Engineering and Construction Company, Orlando, Florida. Portable gas engine driven "Stable-Arc" welders manufactured by the Lincoln Electric Company, Cleveland, Ohio, were used to supply the current necessary for the welding process.

The largest of these buildings—the largest citrus packing house in the world—is owned by the Dr. P. Phillips Company. The building is 117 feet wide by 202 feet long, and due to the welded steel arch design there are no supporting columns in the interior of the structure which contains 200 tons of structural steel.

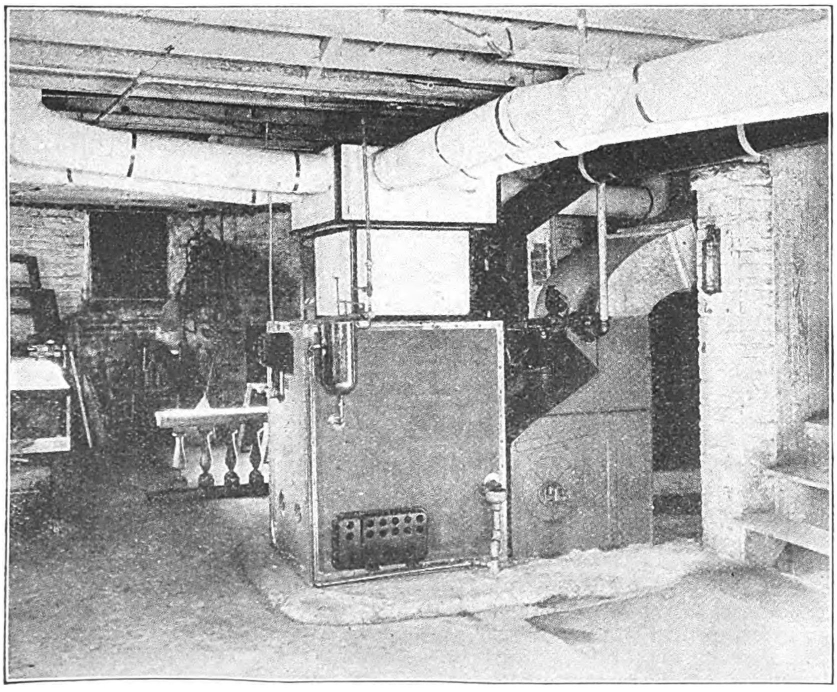
This building was under process of construction when two hurricanes spread disaster in Florida. In the first hurricane the wind blew down the partially completed rear masonry wall, went through the building and blew out the front masonry wall. The arc-welded steel super-structure remained intact, withstanding the terrific strains imposed upon it by the force of the hurricane. Again in the second hurricane, which was more severe than the first, the strength and rigidity of the arc-welded construction was tested severely but the steel framework remained in perfect alignment. Several other buildings of the same design and construction, completed before the hurricanes, survived, although adjacent buildings of other types of steel construction were badly twisted out of shape. With the possible exception of a severe earthquake, no greater test of the strength and rigidity of arc-welded steel construction could be given than was imposed by the Florida hurricanes.

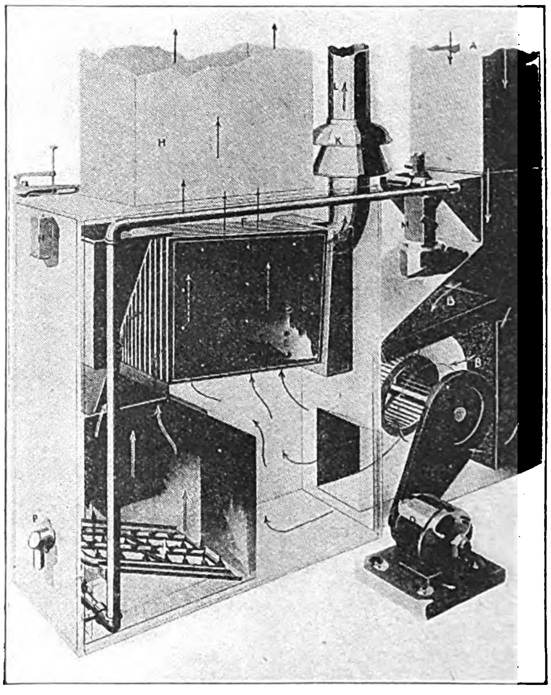
A "Weathermaker" for the Home

DEFICIENCY of moisture in the average American home during the winter months is so marked that rapid deterioration of woodwork and furniture is largely ascribable to this cause, according to an investigation just completed for some of the large carpet manufacturers. These findings bear out to a large extent the results of research by physicians and scientists in governmental and educational institutions in the east, directed at learning the real reasons for irritation of human mucous membranes in cold weather and the high percentage of illness which occurs during the "confined" months. An interesting answer to the problem which this presents to the average householder has been found in the development by Willis H. Carrier of Newark, New Jersey, of the "Weathermaker," a home air conditioning plant containing many of the principles of the large theater and public installations.

While directed at the effect of deficient humidity on inanimate things, the results of this investigation bear out almost entirely the statement made by Mr. Carrier, more than year ago, that human health and comfort depend on proper conditions of humidity to almost as great a degree as on heat and that much home heating is wasted in a futile effort to make up for deficient humidity. Carrier is the engineer who has designed air conditioning ma-

(*Please turn to page* 559)


A home weathermaker installation. This compact plant takes less space than the usual coal furnace and is entirely automatic



Skeleton view of weathermaker to show the progress of air through the plant

Meeting "high gear" competition, speeding up factory production —with this *grainless* wood

Just the right material for increased production—what a problem it is to find. But in scores of industries where strength is vital and lightness an asset, the answer has been found in the use of Masonite Presdwood. To try out Presdwood is to realize its profitable possibilities. Samples for research gladly sent on request.

TAKES COMMERCIAL PAINT FINISHES

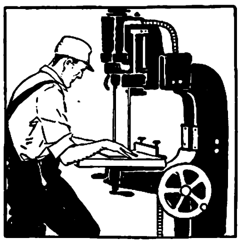
A material that is light, strong, dense, yet easily handled on standard wood working machines — this description but partially tells the manufacturing advantages of Masonite Presdwood. In addition, this sturdy material is naturally beautiful in appearance and capable of taking any commercial finish.

Because Presdwood contains no artificial binder, it does not dull good tools. It is almost impervious to moisture. It does not split or splinter and is highly resistant to warping, buckling, shrinking and swelling.

Still other advantages are uncovered almost daily. Die costs are reduced on punch press operations. Costly rejections in final inspection are no longer encountered. In many, many ways, this grainless wood board is effecting vast savings in modern industry.

For hydroplanes

The lightness of Presdwood has dictated its use for prize winning hydroplanes, both hulls and decks being made of this grainless wood. It is built into toys that are easy for tiny tots to handle. And because of its resistance to moisture, it is ordered in large quantities by makers of outdoor signs. For tops of campers' tables it gives out-of-door convenience without heavily loading the car. In portable billiard tables it provides a perfect surface and keeps down the weight.


EASILY CUT ON THE BAND SAW

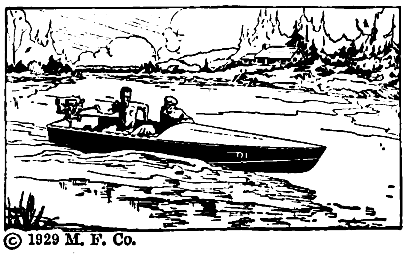
The strength of Presdwood has led to its use in the broad paneled sides of motor truck bodies, on which the buyer's sign can be readily painted. It is used in shipping boxes where merchandise of great value must be adequately protected. It is ideal for show window flooring, office partitions, paneled walls of fine apartments, floors of dance halls and park pavilions, and the decorative ceilings of Pullman-built railroad coaches.

In your business

In your business, too, there is doubtless a place for Presdwood. It comes in four foot boards, twelve feet long. It is also cut to special sizes at the mill. Generous samples gladly furnished. May we send the samples now?

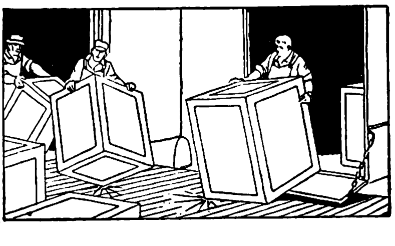
MASONITE CORPORATION
Sales Offices: Dept. 738, 111 W. Washington St.
Chicago, Illinois

FOR FAST HYDROPLANES



Masonite
PRESDWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

FOR STURDY BOXES



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Learning to Use Our Wings

Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York City

The Railroads In Aviation

THERE are now five airways that have a service co-ordinated with railroads. More such co-ordinations will follow. The remarks of General W. W. Atterbury, in an interview given to the *Saturday Evening Post* are very significant in this regard.

When the steam carriage first appeared in England the powerful stage coach companies fought it bitterly, and by special legislation drove it off the highways. The steam carriage took to rails and the advent of the automobile was delayed 75 years.

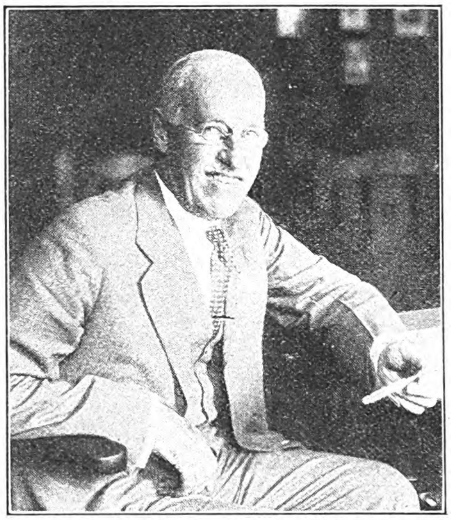
When the executives of the Pennsylvania Railroad realized the advent of air transportation, they had three possible courses that they could adopt: active hostility, indifference similar to that displayed by the railways when the automobile first appeared on the scene, and active co-operation.

Guided by the past history of transportation, they eventually decided on co-operation. They had learned the bitter lesson of loss of traffic and competition from the motor bus.

Each kind of transportation, according to General Atterbury, should be developed in co-operation with the others, with the understanding that each has its own special field in which it particularly excels. This does not mean that railroads should seek control of air-transportation lines. The General thinks that full co-operation can be developed without ownership, and that single ownership might even prove a handicap, because some one branch of the commonly owned services might be neglected.

The great advantage which American aviation has as compared with European aviation is the greater readiness and ability of the American business man to pay extra fares for higher speed and better accomodations. It is apparently no unusual thing for a business man going alone from New York to San Francisco to engage a Pullman drawing room and buy two tickets for the sake of greater privacy and the ability to work on the train.

Considerations such as the above led the Pennsylvania Railroad officials to accept an invitation to a conference in Detroit in 1925, with such men as Henry and Edsel Ford, Howard Coffin, C. M. Keys, and R. E. M. Cowie, President of the American Railway Express. This conference led to the organization of the National Air Transport which is now making air-transport history. After the Lindbergh flight and the enormous growth of American aviation which followed, General Atterbury decided to take action. There followed the formation of the Transcontinental Air Transport, Incorporated, with a capital of 5,000,000 dollars. This united the Pennsylvania Railroad, the Atchison, Topeka and Santa Fé Railroad, and a number of important aviation interests.



General W. W. Atterbury

For the first time the full private story of T. A. T., as it is familiarly called, appears in print.

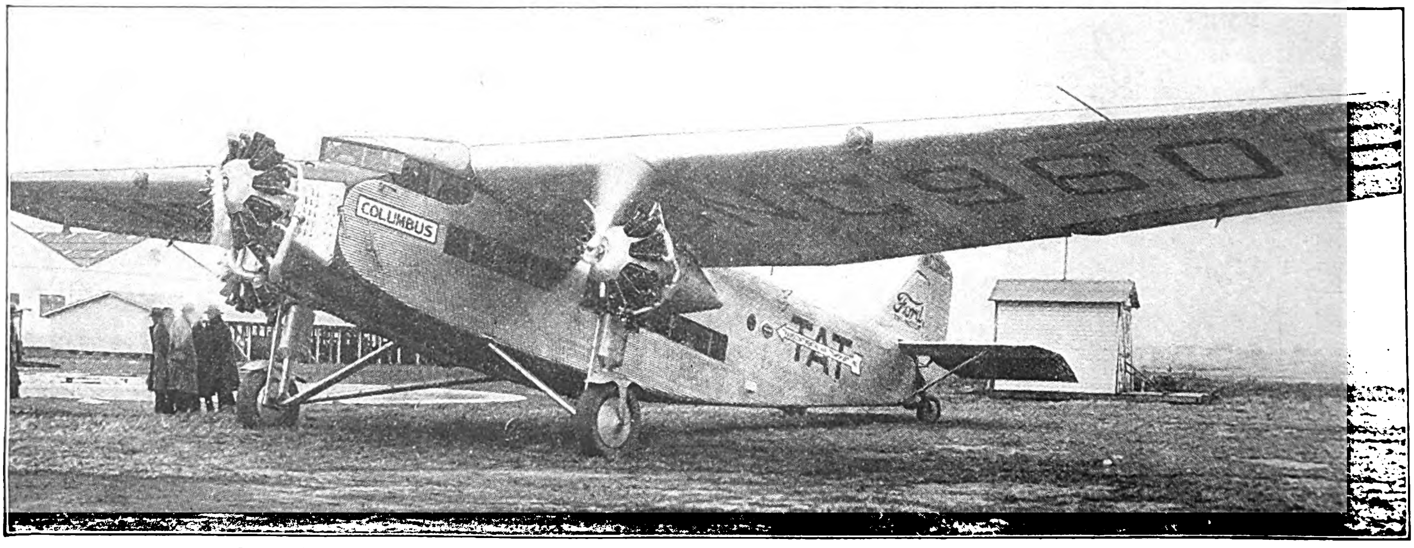
The 5,000,000 dollars was apportioned as follows; 2,000,000 dollars for operation; 1,000,000 dollars reserve for investigation; and 2,000,000 dollars in a general reserve. The technical committee formed consists of Colonel Lindbergh, Casey Jones, and Major Thomas Lanphier.

The transcontinental route was decided upon after careful investigation. It was considered at the outset that the Alleghany Mountain section was dangerous for flying because of the terrain and unsettled weather conditions. Accordingly the first part of the route will be covered by train from New York to Columbus. There passengers will board a plane that will take them via Indianapolis to St. Louis in time for lunch; then to Kansas City and to Waynoka, Oklahoma, for the end of the day's flying. There they will board a Santa Fé train, and reach Clovis, New Mexico, by morning. The second day's flight will end the journey at Los Angeles. In selecting this route, a lower altitude and more settled weather conditions are expected than on the direct airmail route from Chicago to San Francisco. Over the southwestern deserts there is more clear weather and fewer storms than anywhere in the country.

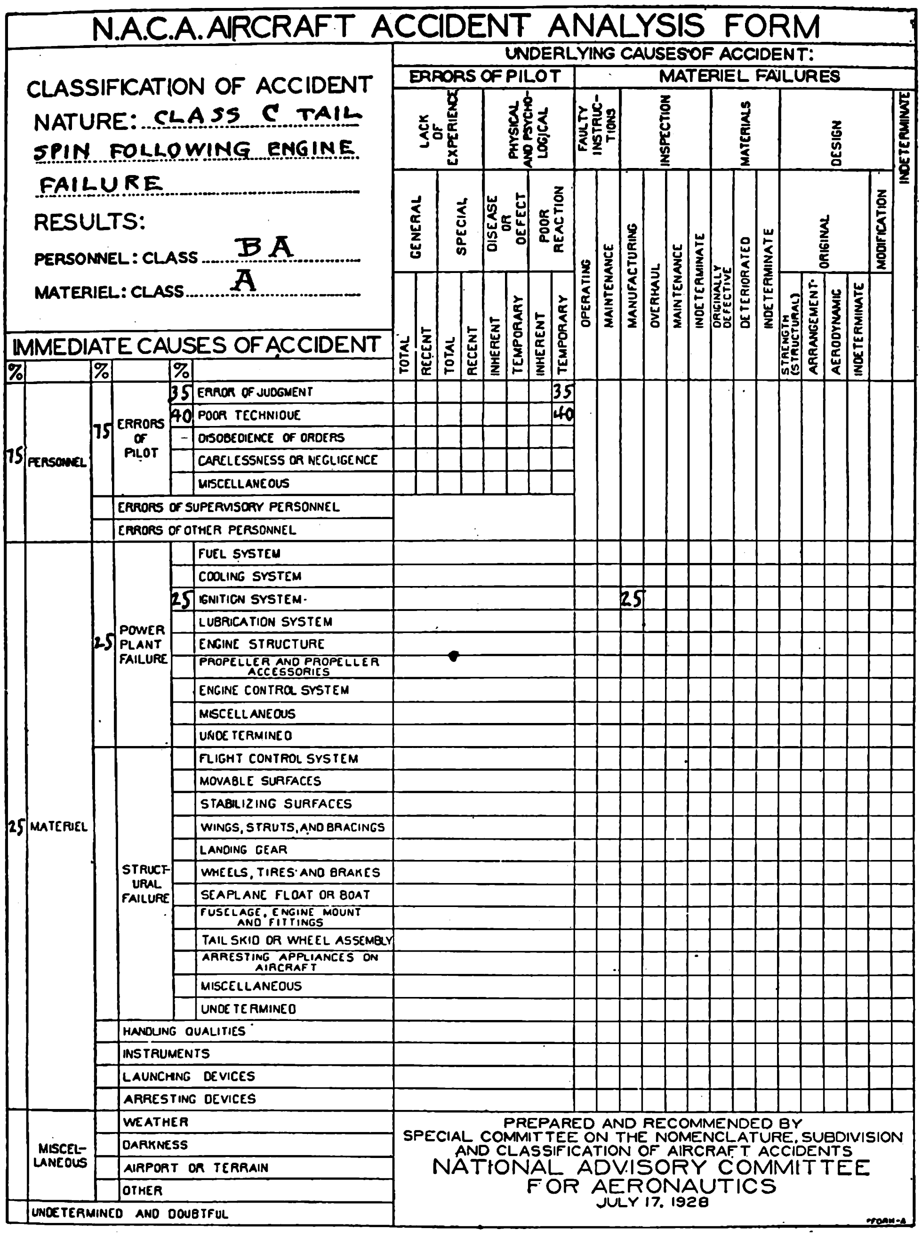
Airports are being installed at 250 mile intervals, with fields located at some distance from centers of cities, so as to give ample landing and get-away runs. A special railroad station has been appropriated for by the Pennsylvania Railroad, about eight miles out of Columbus, to meet the necessity for joining the railroad and the outlying airport. To secure regularity an independent weather service is being organized, combined with complete telephone communication with the ground.

Accident Analysis

THE N. A. C. A. has done a splendid piece of work in issuing a report on "Methods of Analysis of Aircraft Accidents." The work was done with the cooperation of the Army Air Corps, the Bureau of Aeronautics of the Navy Department, and of the Aeronautics Branch



One of the three-motored Ford planes used by Transcontinental Air Transport, Inc.



N.A.C.A. AIRCRAFT ACCIDENT ANALYSIS FORM

CLASSIFICATION OF ACCIDENT

NATURE: CLASS C TAIL SPIN FOLLOWING ENGINE FAILURE

RESULTS:

PERSONNEL: CLASS BA

MATERIEL: CLASS A

						UNDERLYING CAUSES OF ACCIDENT:																						
						ERRORS OF PILOT								MATERIEL FAILURES														
						LACK OF EXPERIENCE				PHYSICAL AND PSYCHOLOGICAL				FAULTY INSTRUCTIONS		INSPECTION				MATERIALS			DESIGN					INDETERMINATE
						GENERAL		SPECIAL		DISEASE OR DEFECT		POOR REACTION		OPERATING	MAINTENANCE	MANUFACTURING	OVERHAUL	MAINTENANCE	INDETERMINATE	ORIGINALLY DEFECTIVE	DETERIORATED	INDETERMINATE	ORIGINAL				MODIFICATION	
IMMEDIATE CAUSES OF ACCIDENT						TOTAL	RECENT	TOTAL	RECENT	INHERENT	TEMPORARY	INHERENT	TEMPORARY										STRENGTH (STRUCTURAL)	ARRANGEMENT	AERODYNAMIC	INDETERMINATE		
%		%		%																								
75	PERSONNEL	75	ERRORS OF PILOT	35	ERROR OF JUDGMENT								35															
				40	POOR TECHNIQUE								40															
				-	DISOBEDIENCE OF ORDERS																							
					CARELESSNESS OR NEGLIGENCE																							
					MISCELLANEOUS																							
			ERRORS OF SUPERVISORY PERSONNEL																									
			ERRORS OF OTHER PERSONNEL																									
25	MATERIEL	25	POWER PLANT FAILURE		FUEL SYSTEM																							
					COOLING SYSTEM																							
				25	IGNITION SYSTEM											25												
					LUBRICATION SYSTEM																							
					ENGINE STRUCTURE																							
					PROPELLER AND PROPELLER ACCESSORIES																							
					ENGINE CONTROL SYSTEM																							
					MISCELLANEOUS																							
					UNDETERMINED																							
			STRUCTURAL FAILURE		FLIGHT CONTROL SYSTEM																							
					MOVABLE SURFACES																							
					STABILIZING SURFACES																							
					WINGS, STRUTS, AND BRACINGS																							
					LANDING GEAR																							
					WHEELS, TIRES AND BRAKES																							
					SEAPLANE FLOAT OR BOAT																							
					FUSELAGE, ENGINE MOUNT AND FITTINGS																							
					TAIL SKID OR WHEEL ASSEMBLY																							
					ARRESTING APPLIANCES ON AIRCRAFT																							
					MISCELLANEOUS																							
					UNDETERMINED																							
			HANDLING QUALITIES																									
			INSTRUMENTS																									
			LAUNCHING DEVICES																									
			ARRESTING DEVICES																									
	MISCELLANEOUS		WEATHER																									
			DARKNESS																									
			AIRPORT OR TERRAIN																									
			OTHER																									
	UNDETERMINED AND DOUBTFUL																											

PREPARED AND RECOMMENDED BY
SPECIAL COMMITTEE ON THE NOMENCLATURE, SUBDIVISION
AND CLASSIFICATION OF AIRCRAFT ACCIDENTS
NATIONAL ADVISORY COMMITTEE
FOR AERONAUTICS
JULY 17, 1928

FORM-A

For analysis, aircraft accidents are charted as above. See text below

of the Department of Commerce. Its purpose was the analysis of all accidents in a uniform manner, so that correct conclusions could be more easily arrived at, and so that analyses of accidents caused by various agencies could be more easily compared.

The principal cause of accident as set down by the Committee was error on the part of the pilot. Pilots' errors are believed to be responsible for 50 percent of all accidents. Further, it was found that the tail spin was responsible for the greater part of the accidents. Tail spins must be eliminated by better design of the airplane and by better training of the pilot.

It is interesting to list the causes of accidents as set down in the report. These are:

Collisions in full flight with other aircraft. Such accidents occur more frequently in summer, when the air traffic is heaviest, than in winter. Evidently better traffic rules and closer observation of existing rules is the remedy.

Collisions in full flight with objects other than aircraft. This includes collisions—while at flying speed, and with power plant functioning normally—with trees, poles, houses, mountain sides, or other obstacles. The remedy lies here in so selecting airport and landing-field locations that obstacles are not present in their vicinity. In fog flying, mountain sides may constitute grave dangers. Here the remedy lies in better methods of navigation so that pilots may feel warranted in flying high above fogs and clouds, and not seek to hug the ground so as to keep landmarks in view.

Tail spins following engine failure. These are commonest on making a get-away climb when the engine suddenly fails. Here the remedy lies in the design of aircraft which will not readily stall or fall off on one wing when they do stall. This is largely a problem of applying modern aerodynamic knowledge to the design of aircraft.

Tail spins without engine failure. The remedy here is similar to that of the previous case.

Forced landings. Forced landings may be due to engine trouble and other defects of the airplane, loss of direction, bad weather, darkness, or exhaustion of fuel. More reliable power plants, better maps and navigation methods, and better weather service are here the obvious remedies.

Landing Accidents. If landing accidents occur while making a normal landing, then the pilot is certainly to be blamed. It may safely be said that all good modern airplanes are so designed that they should give a good landing under normal conditions.

Take-off accidents. This includes accidents occuring between the time of starting a take-off and the time when full flying speed is attained. These, in the writer's opinion, should be very rare on good fields.

Taxying. This includes all accidents which occur while the aircraft is maneuvering under its own power on land or water. Granted good fields, taxying accidents occur only in gusty weather, and when the pilot does not correctly take cross winds into account. With good training of our flying men, such accidents, mainly "ground loops" when the plane makes a turn on the ground, should be very rare.

Fires in the Air. The remedy here is more careful installation of existing power plants, and in the development and use of the aircraft Diesel engine burning heavy fuel.

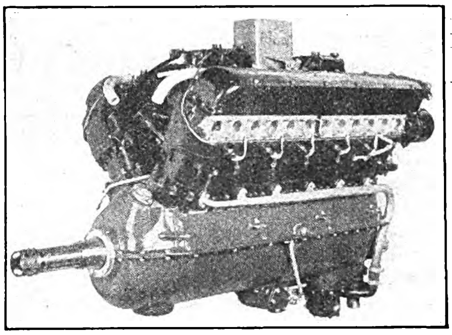
We reproduce herewith the aircraft accident analysis form as finally issued by the Committee. It will be noted that both the Immediate Causes of Accident and the Underlying Causes of Accident are listed. A further advance in accident analysis is made by weighing the causes of accidents. Then each crash can be traced down more closely, and the report of the accident is made more useful to designers and operating personnel alike.

The Conqueror

IN spite of the conviction of air-cooled engine designers that the water-cooled engine is doomed, a good many water-cooled engines are still being built. Among such engines, one of the best is the Curtiss Conqueror.

The Conqueror is a twelve-cylinder engine developing 625 horsepower at 2400 revolutions per minute, and weighing only 755 pounds dry, or about 1.15 pounds per horsepower. The V of the engine includes an angle of 60 degrees, the bore is five and one eighth inches, and the stroke six and one fourth inches. Two high-tension magnetos, and two dual type carburetors, are employed. When geared down two to one, the engine weighs 845 pounds, which is still a very moderate weight. The fuel consumption is .53 pounds per horsepower hour, and the oil consumption .015 pounds per horsepower hour.

It may be asked how designers have reduced the weight of engines of this type. First, by very skilled design. Calculation and long experience have allowed the dimensions of all parts to be reduced to almost their minimum. Second, by the employment of the very strongest materials, particularly nickel-alloy steels, which are used in crankshaft, connecting rods, oil-pump shafts, propeller hub, et cetera.



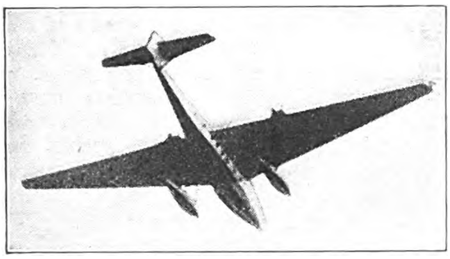
Side view of Curtiss Conqueror

As can be seen from the photograph, the engine is very compact and has a small frontal area which is important from the point of aerodynamic resistance. With the air-cooled engine, the new types of cowling now coming into use shelter the projecting cylinders, but have the disadvantage of impeding the pilot's vision when placed in the nose of the fuselage. When a company such as Curtiss still holds to the policy of offering a large water-cooled engine for commercial plane design, we may draw the conclusion that the water-cooled *versus* air-cooled controversy is not yet closed.

A Seaplane Designer's Views

WE have received a personal communication from Dr. Adolph Rohrbach, German designer of many successful flying boats, which contains several points of interest.

The Rohrbach Company has received an order from the German Lufthansa for three large flying boats of the Rohrbach Romar type, which are to be put into service this summer between Europe and South America.



A Rohrbach Romar in flight

The Romar is equipped with three 12-cylinder B.M.W. engines of 720 horsepower each. The span of the tapered wing employed is 121 feet, the overall length is 72 feet, the overall height is 28 feet, and the wing area is 1830 square feet. In the design of a cantilever monoplane wing, two objectives have to be attained: one, the greatest possible aerodynamic efficiency, the other the greatest possible strength at the root of the wing. Dr. Rohrbach points out that he has tapered his wing considerably more than has been the practice hitherto, since the width of the tip of the wing is only one fifth of the width at the center of the wing. This evidently gives enormous strength at the foot. At the same time, the huge width at the center protects engines and propellers completely from spray. In flying boat design, hydrodynamic problems are just as important as aerodynamic problems.

In the design of small, conventional airplanes, practice has become so far standardized that it is possible to lay out a machine with comparatively little experimentation. In the design of very large boats, there can be no mistakes allowed. Even a minor error may involve tremendous expenditures during the test-flight stages.

In the design of the Romar, the wind tunnel was freely employed and several hundred wind-tunnel tests were made. We know from personal experience that the best American designers employ wind-tunnel methods to an equal extent.

Seaworthiness of large flying boats is also a fit subject for laboratory experimentation. In the wind tunnel the model is stationary while a stream of air is blown past it. In the water basin, the model is drawn rapidly through the tank, and measurements are made by automatically recording apparatus. The Romar was subjected to 2000 towing runs, covering a distance of 600 miles during such travel.

As a result of this work, the Romar is said to have excellent seaworthiness. Our photographs indicate that the flotation arrangement comprises a comparatively narrow central hull, and two large side floats placed near the main hull instead of two small wing tip floats. This arrangement of floats has not been frequently employed in the United States, but apparently deserves consideration.

The gross weight of the Romar is 42,000 pounds. The loading per square foot is therefore 23 pounds. It is by employing such high loadings per square foot that a useful load of nearly 50 percent and a high speed of 135 miles an hour are obtained, with a range of some 2500 miles. In the average American commercial airplane of to-day, the loading rarely exceeds 10 pounds per square foot of wing area. For seaplanes, 12 pounds per square foot is a good figure. If Rohrbach can get by with 23 pounds per square foot for a flying boat, perhaps higher loadings are indeed legitimate for such craft.

What Is An Air-Scout?

FOR many years we have been familiar with the admirable work of the Boy Scouts. Now the Air Scout has appeared on the scene. The *Aeronautic Review* announces that the Omaha Chapter of the National Aeronautic Association has organized an Air Scout Troop. The boys are being instructed in aviation matters, and by passing suitable tests can secure a One Wing Badge, then the Clipped Wing, then the Full Wing Badge. The tests include such questions as: What is an airfoil?; What is the shape of the propeller blade?; What is the construction of the landing gear?; et cetera.

It will not surprise us if in a few years time each troop of Air Scouts has its own light plane, and boys of 15 years of age or so are sallying forth to the flying field for practice and cross-country flight! The younger generation will certainly be more air-minded, fly more, and learn to fly with greater ease than we do now.

Buying Planes on Installment

IN the last ten years finance companies have helped to increase the sale of automobiles to their present vast proportions. Now the Aviation Credit Corporation proposes to finance the sale of airplanes on similar lines. A private owner will be able to purchase a plane by making a down payment of one third of the price of the plane, and the rest in 12 monthly payments. The purchaser has also to pay a reasonable premium for insurance.

A dealer in airplanes can get still more liberal accomodation, and has only to pay 10 percent of the wholesale price. There are some dangers in the plan. It is doubtful, for example, how much value a repossessed plane will have, and whether it will be possible to sell the repossessed plane with the same certainty as a repossessed automobile. At the same time the plan is likely to be of great assistance to the industry, and we shall watch developments with real interest.

An Aviation Guide

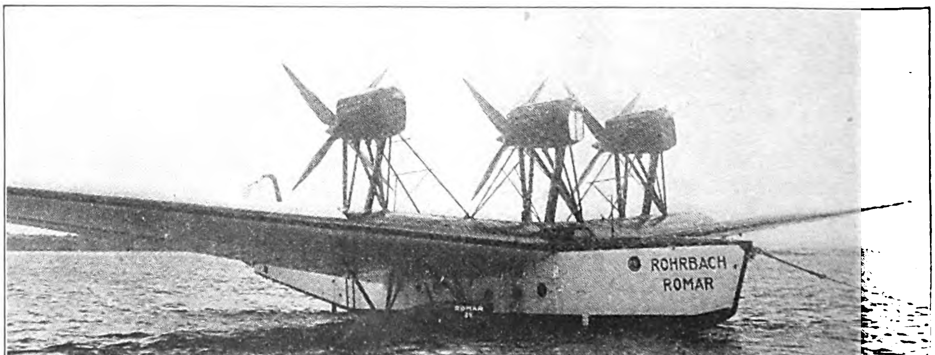
SEVERAL months ago we spoke of the elaborate airway guides published in European countries. Now the *American Official Aviation Guide*, published by John R. Fletcher (Chicago) has made its appearance. Nothing is so reassuring as regards the growth of American air transport as this interesting monthly publication. The index lists 30 airways. Six carry passengers, mail, and express; seven carry passengers and mail; eleven carry passengers only; the rest are engaged solely in mail, or mail and express work.

Five airways have plane-train connections, namely the Northwest Airways; Stout Air Lines; Standard Air Lines; Universal Air Lines: and Pan-American Airways. The American Railway Express Company has contracts with ten airways and lists rates between a great many cities with charges varying from 25 cents to 75 cents per quarter of a pound. In a few years time the aviation guide will be as common-place as a railway guide is now. For the time being it presents real interest.

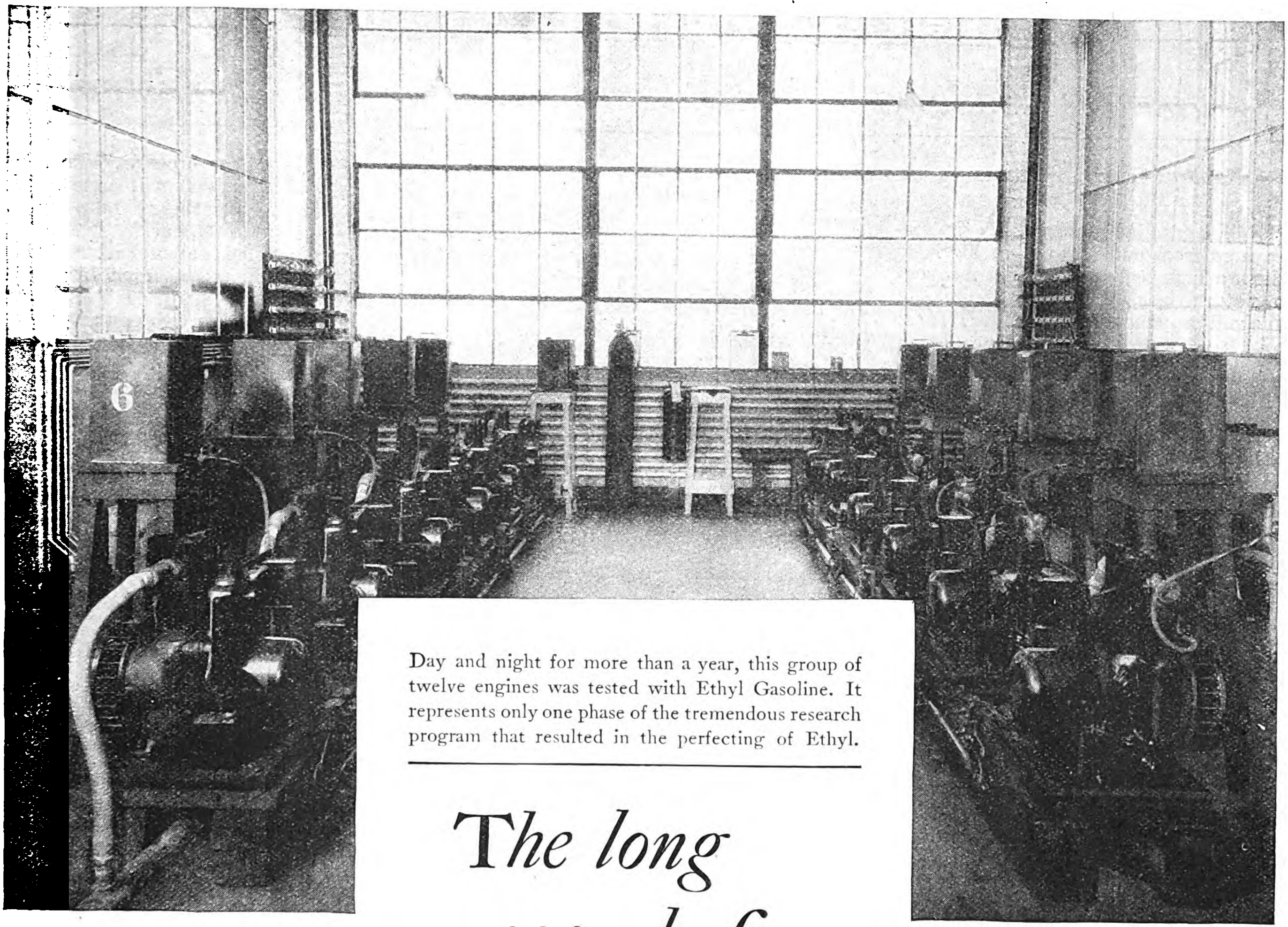
Let us quote from the announcements of Northwest Airways: "*Fare* between Chicago and St. Paul, 35 dollars, including transportation to and from airports at both terminals. *Equipment*, 16-passenger Ford-Stout tri-motored all-metal cabin monoplanes. Stewards, et cetera. Baggage and toilet facilities. Powered with three 410 horsepower Wasp motors. Maximum speed is 135 miles per hour. Metal propellers, flares, and landing lights. *Rail Connections.* Northwest Airways Service is maintained in co-operation with the Northern Pacific, Great Northern, Chicago, Milwaukee & St. Paul, et cetera.

"Airways schedules are so arranged that planes leaving the twin cities shortly after the arrival in the morning of trains from the Pacific Coast reach Chicago in time to make connections with fast trains for the east, thus effecting a saving of an entire day in a transcontinental trip."

This extract from the guide gives a better idea of the actuality of air transport than the most romantic word picture of a skilled writer in our best magazines.



One of the sturdy flying boats designed by Dr. Adolph Rohrbach



Day and night for more than a year, this group of twelve engines was tested with Ethyl Gasoline. It represents only one phase of the tremendous research program that resulted in the perfecting of Ethyl.

The long search for

A Better Motor Fuel

EVEN among technically minded people, there are very few who realize the infinitely painstaking research which must precede any positive contribution to the improvement of a motor fuel.

Before Ethyl Gasoline was offered to the public, tests like the one illustrated were carried on for more than seven years in the Research Laboratories of General Motors.

Then Ethyl was subjected to ruthless experimentation by the laboratories of the outstanding oil companies of the United States, Canada and the British Isles. Having proved its worth for themselves, they now mix Ethyl fluid—containing tetraethyl lead—with their good gasoline to form Ethyl Gasoline.

The country-wide distribution of Ethyl has encouraged automobile manufacturers to build cars of higher compression. The combination of high compression engines and Ethyl Gasoline has created a new standard of motoring comfort and efficiency.

Whatever your car will do on ordinary gasoline, it will do better on Ethyl.

ETHYL GASOLINE CORPORATION, 25 Broadway, New York City
56 Church Street, Toronto, Canada. 36 Queen Anne's Gate, London, England

GOOD GASOLINE *plus* ETHYL FLUID *equals* ETHYL GASOLINE

ETHYL GASOLINE

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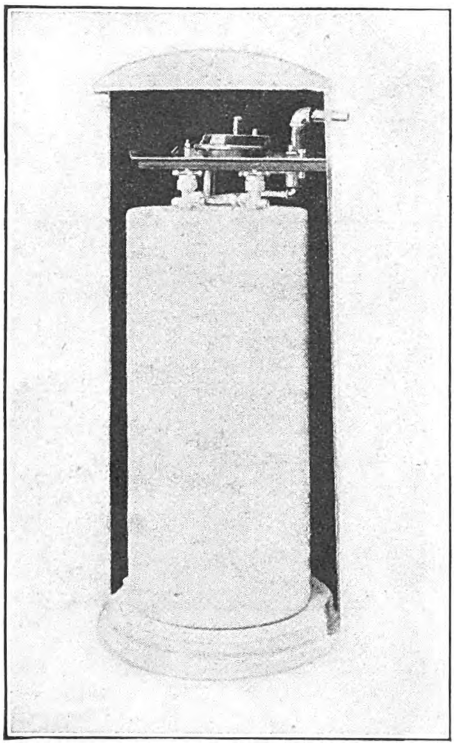
Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

Natural Gas Byproducts Find New Uses

THE best gasoline motor fuel is that recovered from natural gas—casing head gasoline, a high-test fuel. In its recovery from natural gas, a certain amount of butane and propane is also obtained. These constituents are not desired in the gasoline fraction because of their high volatility, which renders the gasoline "wild." Elimination of these constituents by weathering of natural gasoline was formerly practiced, but this system resulted in a large loss of the desired hydrocarbons, including much pentane and considerable hexane. A variety of methods for the controlled fractionation of wild gasoline were therefore developed, as a result of which the recovery of propane and the butanes was possible, either mixed or, by refractionation, as separate products.



Container in which liquefied propane gas is delivered for domestic use where gas-mains are lacking

These liquefied petroleum gases have recently assumed substantial industrial importance for a variety of purposes. One of the earliest applications of these liquefied gases was for household fuel use as a substitute for city gas. Such applications are naturally restricted to the areas in suburban and country districts which are beyond the reach of city-gas supply. Under present conditions this would correspond, in actual cost to the customer, approximately to city gas at two dollars per thousand cubic feet, assuming a 530 B. t. u. manufactured gas.

A number of reports have been made on the use of propane and butane as an enricher for blue gas to be used in city-gas supply. A number of industrial uses, for manufacturing chemical compounds, for refrigeration, as solvents, et cetera, have been suggested in addition to the fuel applications. It has been estimated by one of these producers that during 1928 approximately 7,000,000 gallons were manufactured, and it is forecast that this output will be considerably increased during the present year.

White "Blue-Prints"

WHITE "blue-prints" are the invention of German chemists, and the paper is manufactured in that country under the name Ozalid. Copies of tracings reproduced on this paper show black on white and have the additional advantage of being geometrically congruent with the original drawings because the paper is not wet during the developing and hence can not shrink. The developer is ammonia vapor.

A Swedish inventor, N. A. Persson, has recently patented a quick-developing apparatus for Ozalid paper in which the developing is carried out with gaseous ammonia, which is introduced into the closed apparatus from a steel cylinder containing liquid ammonia. An even distribution of the gas over the exposed surface of the paper is obtained by placing a cloth of woolen felt against it. The time required for the developing can be further reduced by moistening very slightly the reverse of the paper, which can be done without any risk of shrinking. The apparatus is provided with a ventilation device and is practically odorless in operation.

Why the Glow-worm "Glimmers"

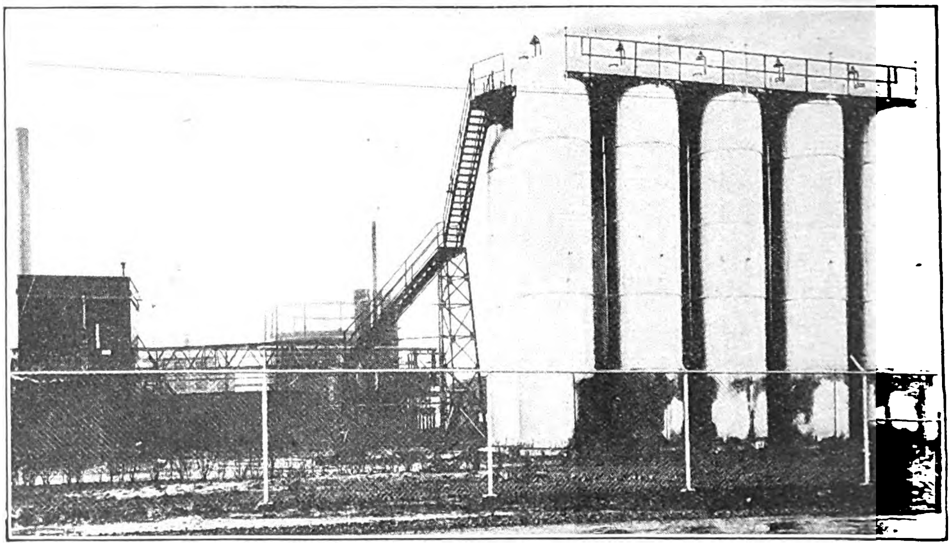
PERHAPS scientists are a step nearer the solution of the mystery that every fire-fly takes as a matter of course—the production of "cold" light. At least, Dr. E. Newton Harvey, professor of physiology at Princeton, appears to have reduced the production of light to a chemical basis. "The question as to whether we shall ever be able to reproduce living light becomes the question of whether we shall ever be able to synthesize the proteins," he says. "Personally, I think that will come in the future. We now synthesize fats, sugar, and some of the polypeptids, which are simple proteins. It is only a matter of time for synthesis of the more complicated compounds of which luciferin is a member.

"Water and oxygen are known to be necessary in the production of this light. It is likely that some material produced by the cells of the animal is oxidized," he said. "This material is called luciferin. Not only one material but two materials are found in addition to water and oxygen. Luminous extract of an animal can be separated into two parts, one containing luciferin, which will oxidize with the production of light and the other part containing a catalyst or enzime, which accelerates the oxidation of luciferin. Chemically, luciferin is probably to be placed among the simplest members of the proteins, the peptones or protesses."

Lighter Concrete Made With Sintered Aggregate

METHODS for the production of lightweight aggregates for concrete have been the subject of numerous patents since 1867, the Department of Commerce points out. It is, however, only recently that the industrial importance of such materials has been fully appreciated. Low-grade clays, shales, and shale rock when heated rapidly at about 2000 degrees, Fahrenheit, for a short period of time expand to two and one half to three times their original volume. Material sintered in this fashion when subsequently crushed and used as concrete aggregate yields concrete of the same or somewhat larger compressive strength and of only two thirds the weight of concrete made with ordinary rock and sand aggregate. The decrease in dead weight resulting from the use of these materials effects a considerable saving in the cost of structural steel for large buildings, bridges, et cetera.

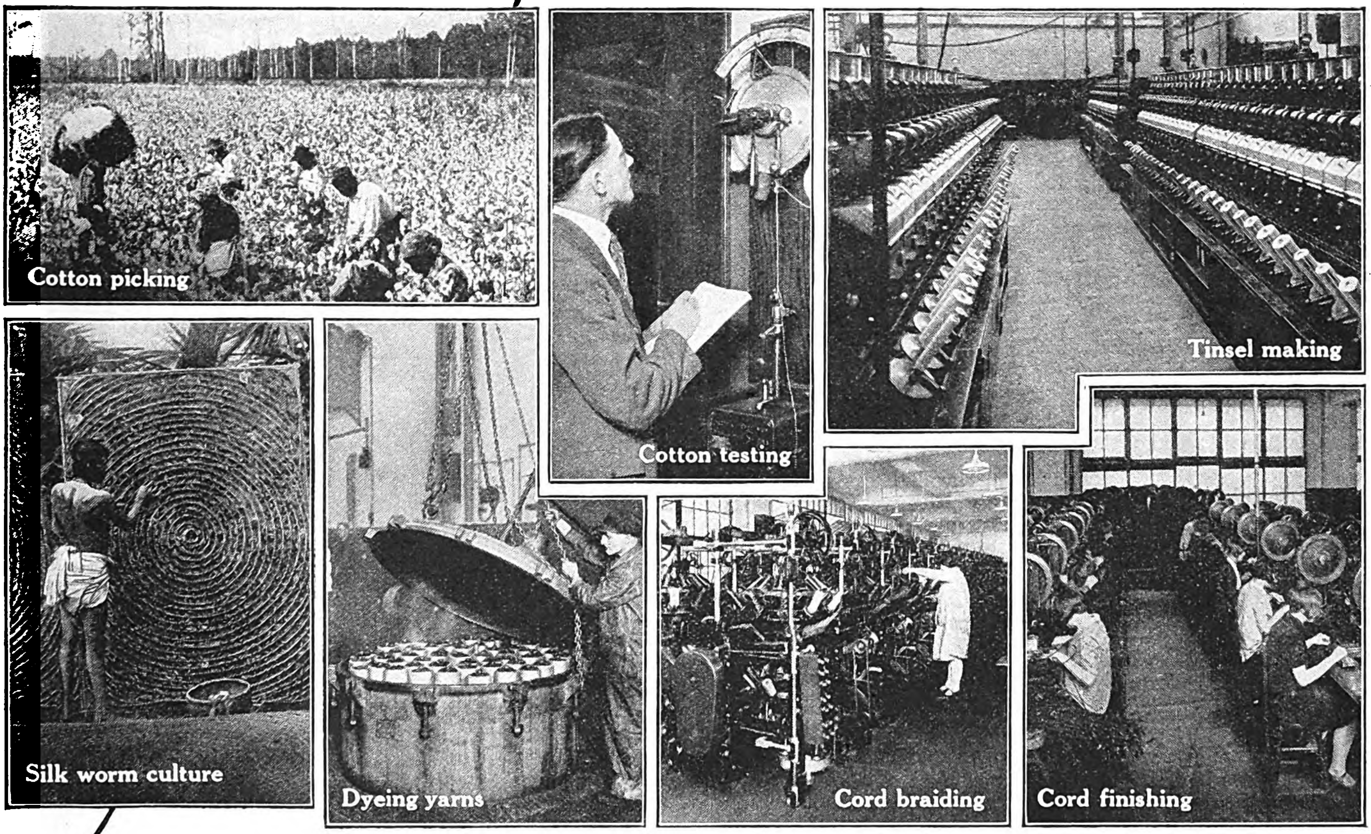
In view of the importance of this new



Liquefied petroleum gases, derived as byproducts during the extraction of gasoline from natural gas, are being used to enrich ordinary manufactured gas. The gas holders shown in the illustration are for peak-load demands

Only a telephone cord..

... but see what's behind it!


Cotton picking
Cotton testing
Tinsel making
Silk worm culture
Dyeing yarns
Cord braiding
Cord finishing

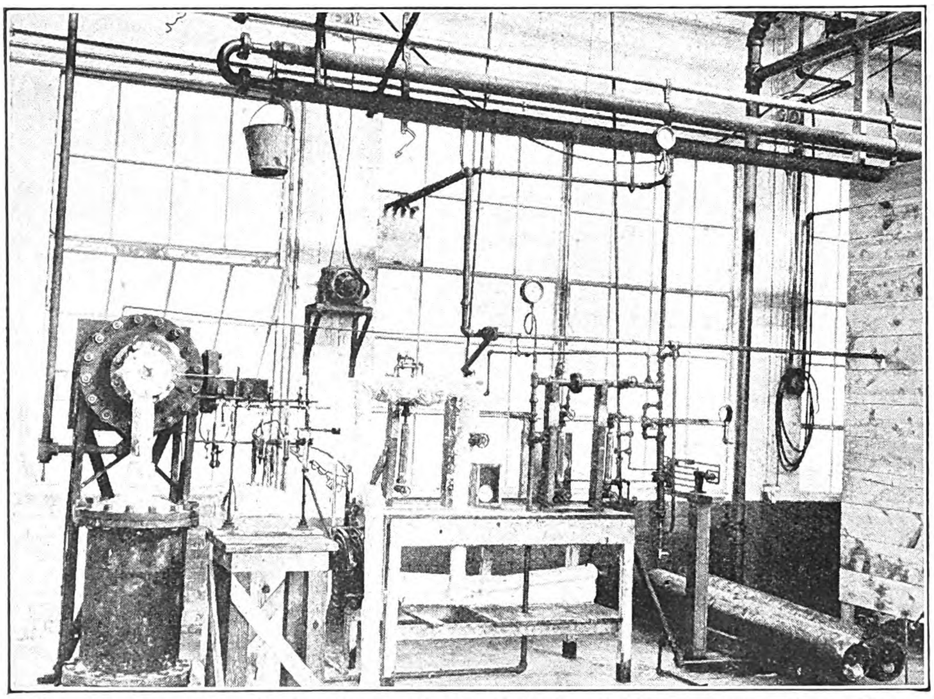
JUST a few feet of insulated wire leading from your telephone to the bell-box—but back of it is a long story of careful workmanship and alert inspection.

Cotton was grown and silk was spun to make that insulation. Wire was drawn into the finest tinsel, covered with the dyed threads, and twisted and braided. It was all done right, because the cord must be rugged enough to take a good many pinchings by desk drawers and still keep on playing its part in a telephone conversation.

This cord is a little thing. But it is just as important to good telephone service as is a fifty-position switchboard or a thousand mile cable. And Western Electric makes it with the same care.

Western Electric

MAKERS OF YOUR TELEPHONE



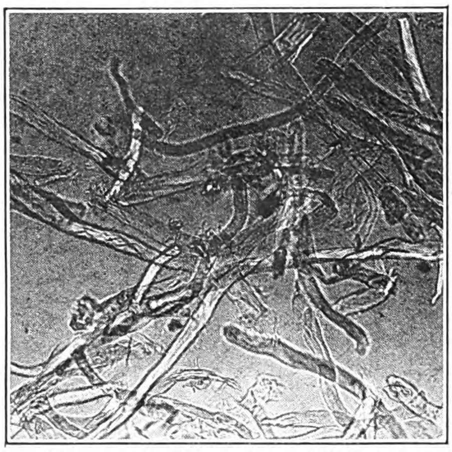
An experimental unit for the synthesis of nitric acid from ammonia, at the Experimental Station of the Hercules Powder Company at Kenvil, New Jersey

industry as evidenced by the number of inquiries concerning the deposits of clays and shale available for the manufacture of light-weight concrete aggregate, the Non-Metallic Minerals Experiment Station of the United States Bureau of Mines, in co-operation with the Ceramics Department of Rutgers University at New Brunswick, New Jersey, is planning to start a survey of such deposits, and a laboratory investigation of the fundamental factors involved in the manufacture of these aggregates.

Modern Research "Lab" Studies Explosives

"You better not fool with a bumble bee.
If you don't think they'll sting, you'll see!"

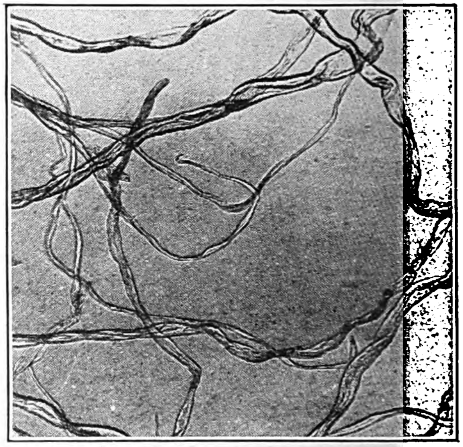
Somehow, that couplet from James Whitcomb Riley's "Child Rhymes" always comes to mind when we visit an explosives plant and see the employees nonchalantly peering over the edge of a nitrator containing enough nitroglycerine to eradicate a whole city. Yet, even as the "Raggedy Man" knew how to handle the bumble bee, so do the hardy denizens of explosives plants go about their jobs with a wholescme appreciation of the danger but still calm in the knowledge that they know their business.



Knowing the explosives business, however, is a mansized job, and it was the ambition to seek out all the kinks and quirks of their numerous products that led the Hercules Powder Company to establish an Experimental Station at Kenvil, New Jersey. Started in 1918 with 20 persons on the staff, the number has grown to 160, of whom 80 are technical college graduates. The personnel of the station is divided into ten main divisions, designated as follows: explosives, smokeless powder, ballistic testing, nitrocellulose, naval stores, physical chemistry, analytical laboratory, library, maintenance, and office.

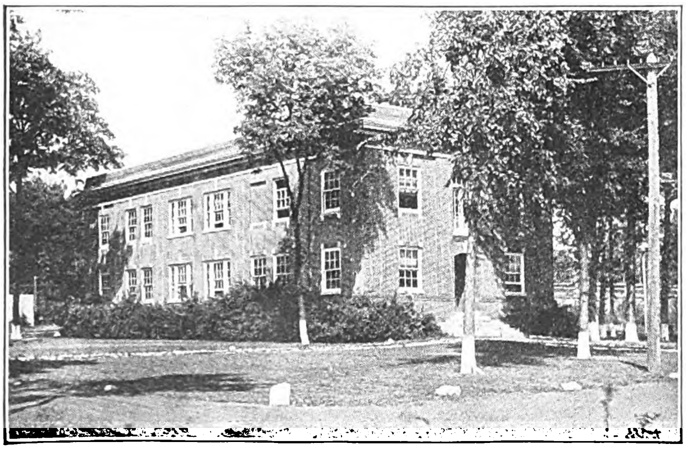
Chlorine in Condenser Cooling Water Pays Dividends

AN interesting development in the power world is the continuous sterilization of the cooling water for engines and turbines by the addition of a measured trace of chlorine gas, generally about one part per two million, which prevents the formation of organic growths on the inside of condenser tubes and keeps the rate of heat transmission at a maximum. On these lines the highest vacuum is maintained, and a serious drop in efficiency prevented, while the troublesome and costly hand-cleaning of the condenser tubes is eliminated. The method is also being used for the prevention of the growth of slimy deposits in cooling water towers, and for eliminating the growth of mussels and other shell fish in pipes when brackish water or sea-water is employed.



Above—Cellulose fibers, highly magnified, before nitration. *Left*—the fibers changed to gun-cotton

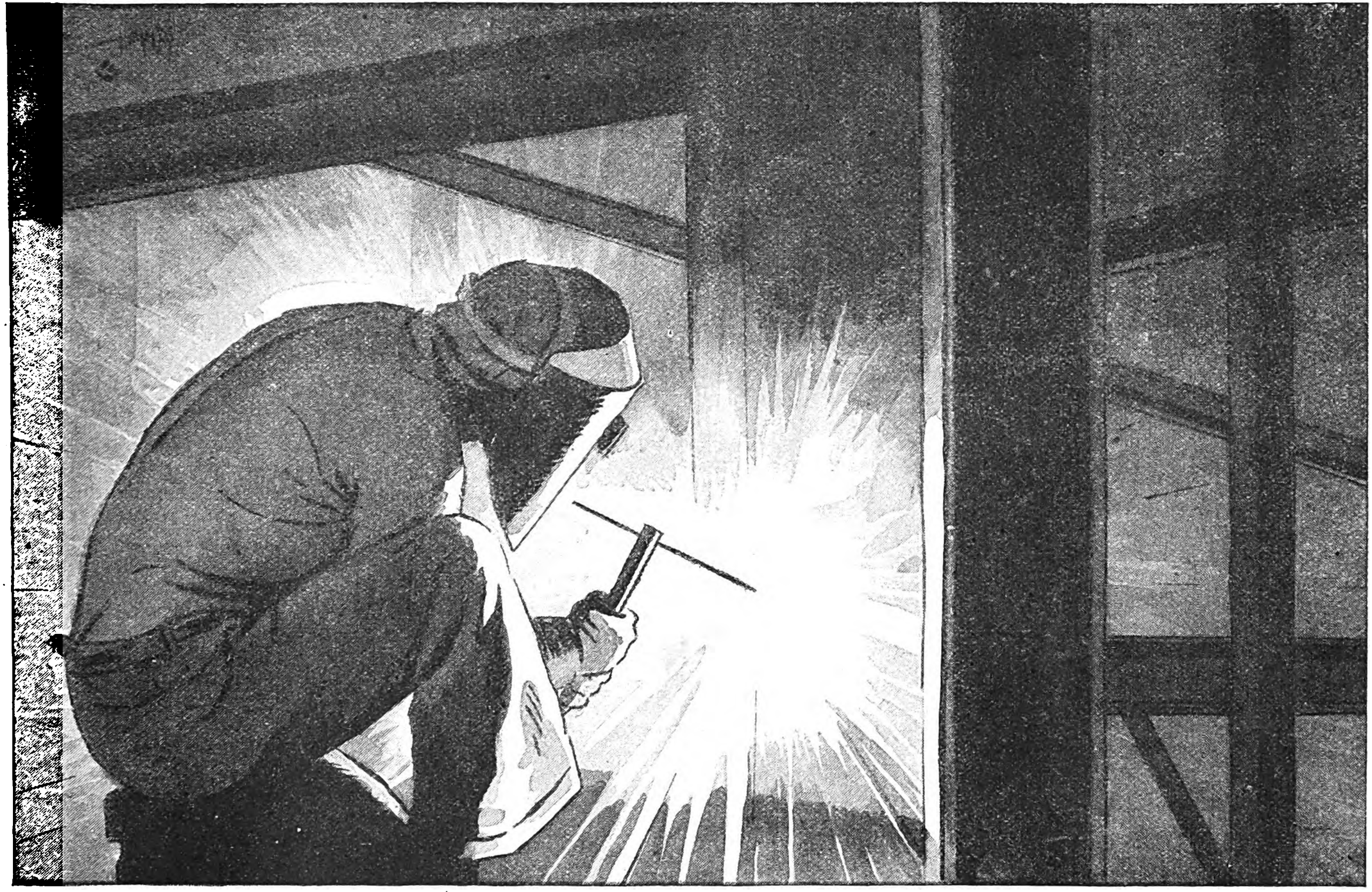
As typical of the results being obtained, the apparatus used in one power station handles an average amount of 72,000,000 gallons of cooling water per day, and from careful records it has been shown that the saving in coal consumption is 8000 dollars a year because of the increased efficiency of the turbines, while in the same period the net reduction in operating costs amounts to 4500 dollars.



One of the laboratory buildings at the Experimental Station, devoted to tests with nitrocellulose products

The Ballastic House at the Hercules Experimental Station, where all of the research work is directed

WHAT WESTINGHOUSE IS DOING IN RESEARCH



WESTINGHOUSE ARC-WELDING NOW MAKES IT POSSIBLE TO ERECT STRUCTURAL STEEL WITHOUT RIVETING

Meet the silent steel-worker

He carries no nerve-wracking hammer, uses no rivets. With a rod in hand, and trailing a bit of wire, the silent steel-worker *welds* steel beams—electrically, quietly, securely.

Only a tiny sputtering arc marks his activity. But under its glow is a concentration of heat that fuses cold steel instantly. Joints knit together with a bond of steel itself. The skeleton of a building becomes in fact a single piece of metal, faithfully fashioned after the architect's plan.

Owner, builder and neighbor alike have been enthusiastic in their approval of the silent method of erecting steel-work. An arc-welded structure equals or exceeds the strength of the same structure designed for riveting; yet twelve per cent less steel is used. Work progresses more rapidly; for much preliminary punching, fabricating and detailing can be eliminated.

Westinghouse was first to apply its arc-welding equipment to large building operations and thus ushered in the silent steel-worker. Westinghouse delves into every possible application of electricity—to give industry better tools, to bring new conveniences to the home.

The Sign of a Westinghouse Dealer

Westinghouse
Electrification
Appliances Apparatus
Wiring
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W
WESTINGHOUSE ELECTRIC

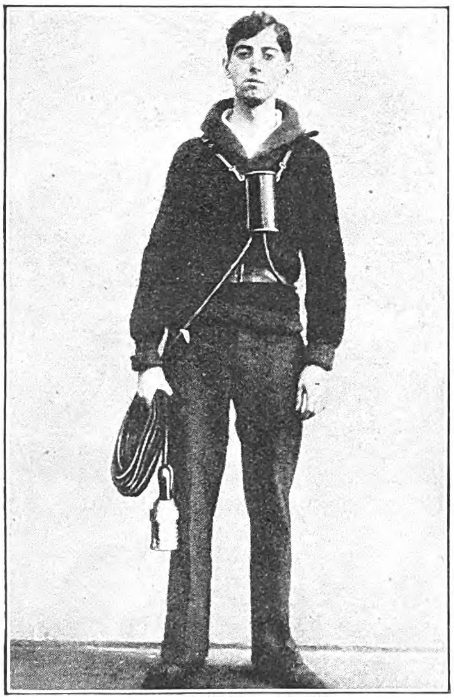
Westinghouse

The apparatus consists of an arrangement of reducing and control valves with a metering mechanism affixed to a panel which is connected to cylinders of chlorine; a sulfuric acid seal is included in the circuit, so that the chlorine gas inside the apparatus is kept dry, which prevents any corrosive action. The chlorine gas is first dissolved in a small portion of the water, and by-passed through an absorption apparatus, a very dilute solution of chlorine being discharged to the bulk volume so as to insure absolutely uniform chlorination.

Novel Device Tests Explosibility of Vapors

A PORTABLE instrument that detects immediately the presence of a wide range of combustible gases or vapors, and indicates whether or not the atmosphere containing these gases is safe, has just made its appearance. This device was first developed by the engineers of the Union Carbide and Carbon Research Laboratories for the detection of methane or firedamp in coal mines. The indicator utilises the effect of combustion of inflammable gas and air mixtures on the surface of a heated filament. This combuston increases the temperature, and consequently the electrical resistance, of the filament. This change in resistance causes the needle of a meter to move over a scale from which the desired information relative to gas conditions is obtained.

For the operator who desires to know the percentage of a known combustible gas present in a mixture of that gas and air, the meter scale reading is taken and then referred to the particular curve or chart relating to that gas. From the curve chart the operator reads directly the percentage of gas present corresponding to the scale reading of the meter. If an unknown mixture of gases exists, and the operator desires to know whether or not the mixture is explosive, the meter scale reading is taken and referred to a "Percent of Explosibility" curve.



Left and Above: Front and rear view of indicator for testing the explosibility of combustible gases and vapors in mines and oil tanks

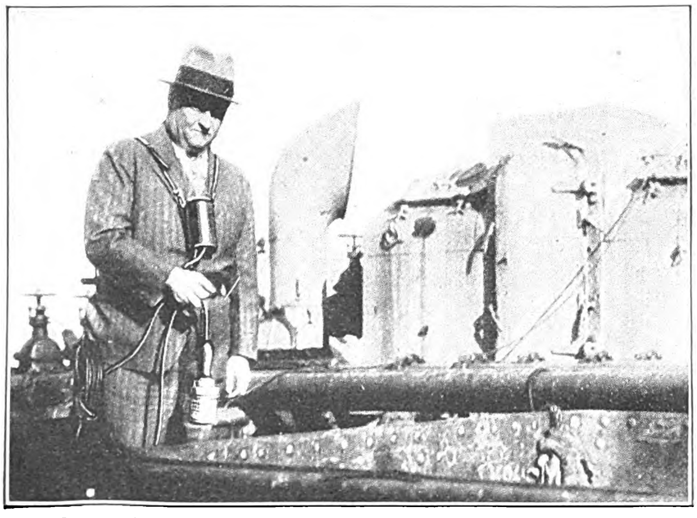
Especially for those concerned with gas testing in and about oil tankers, oil and gasoline storage tanks, tank cars, oil refineries, and the like, the scale is also divided into a white section and a red section. If the meter needle comes to rest anywhere in the red section an atmosphere containing 0.2 percent or more of combustible gas (expressed as pentane vapor) is indicated, showing that the atmosphere is unsafe to breathe without gas masks and unsafe for any work that requires heat, or fire, or is likely to emit sparks.

Using the portable indicator for a test to determine the explosability of vapors in an underground tank

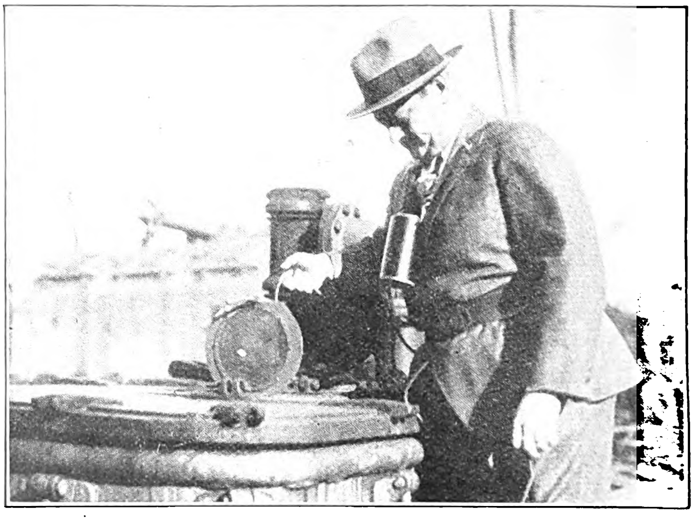
The indicator has been found to operate satisfactorily and safely in explosive mixtures of the following gases and vapors: Methane, ethane, propane, butane, pentane, hexane, gasoline, ethylene, propylene, benzene (benzol), acetone, totuol, ethyl ether, methyl alcohol, ethyl alcohol, propyl alcohol, butyl alcohol, amyl alcohol, hydrogen sulfide and carbon bisulfide.

Preserving Foods by Freezing

PRESERVATION by freezing—one of the oldest methods known to man—is not entirely satisfactory when applied to fresh fruits and vegetables, according to E. F. Kohman, of the research laboratories of the National Canners' Association, who points out that the tissue-destroying



Preparing to test a compartment of an oil tanker which is undergoing repairs, with the portable indicator



The explosibility of vapors in storage tanks, mines, refineries, and other dangerous places is determined enzymes of the fruits and vegetables are not destroyed but merely inhibited, and that they will resume activity immediately upon thawing. When frozen in the raw state, the freezing process disrupts vegetable tissues to the extent that upon thawing they are soft and not in good condition. Precooling, however, leaves vegetables in a condition where they may be frozen without such injury.

The addition of sugar to fruits before freezing assists in the preservation by extracting moisture and approaches the conditions obtaining in dehydration. Theoretically, corn sugar and levulose (fruit sugar) are twice as effective in this respect as cane sugar, owing to the smaller sizes of their molecules.

Light-Sensitive Resins Used in Decorating Metals

HOW the ingenuity of a chemist in a watch factory led to a discovery of a process which has proved a boon to the lithographer is told by M. C. Beebe in a recent issue of *Chemical and Metallurgical Engineering*. "My interest in the possibilities of finding new light-sensitive bodies," says Mr. Beebe, "developed when I sensed the need for new methods of decorating cases at the Wadsworth Watch Case Company, of Dayton, Kentucky.

"The idea of etching watch cases was old, but it had never been successfully developed on a commercial basis. The light-sensitive substances known in the photo-engraving art were chiefly asphaltum and glue or albumen, the latter two sensitized by dichromate.

"Some oil varnishes were known to be good etching resists, and it was logical to attempt to sensitize them so that they might be adaptable to the photographic method. It seemed reasonable to suppose that synthetic resins might be used as light-sensitive media, especially as many of these condensation reactions are exothermic. The fact that furfural aldehyde was known to change its color when exposed to light confirmed the conviction that we might find in some such resin a good lead to follow.

"On the whole the furfural resins seemed to give the most promise, since they printed faster than the other classes of synthetic resins investigated. With suitable dyes incorporated in their solutions, the resinous materials are best adapted to the making of glass positives used in the lithographic trades, to the coating of metal lithographic printing plates to form a tougher image, and for coating copper or zinc plates for photo-engraving. Keeping qualities of the solution are excellent, and coated plates may be kept for considerable periods of time ready for use; also local development may be done in successive steps as its results are proved, until satisfactory."

Oil Burners Create New Demand For Copper

APPROXIMATELY five million pounds of copper are consumed annually in the manufacture of oil-burning installations, according to a survey by the Copper and Brass Research Association. The survey discloses a striking recent exploitation of the field for household oil-heating apparatus. In 1919 the first approved oil heater for homes was listed. Five years later there were less than a dozen approved

(*Please turn to page 564*)

"We can't shut down Number Six! Get it running!"

ANY MAN who puts old-type flexible couplings in a plant is flirting with disaster.

Shut-downs cost money. One machine often stops a whole plant operation.

But as long as machines are connected by couplings made with flexible pins, bushings, springs, discs or grids that fatigue and fail—shut-downs for repairs are bound to get you!

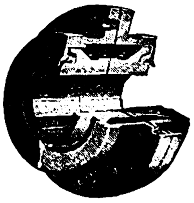
Banish Shut-downs

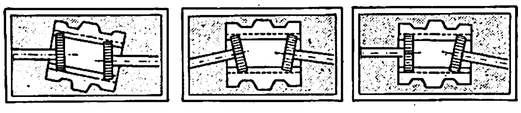
It is all so unnecessary. Thousands of plants have banished shut-downs forever by equipping direct-connected machines with Fast's Self-Aligning Couplings.

From huge rolling mill drives down to one-inch shaft pumps, fans and other machinery, Fast's coupling absolutely eliminates all chance of failure—because it has no flexible members to fatigue or fail, nothing to wear out, nothing to be replaced.

Start to Stop—Now!

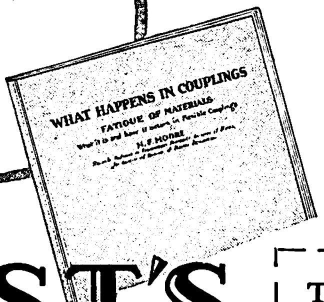
Stop future shut-downs for coupling repairs by seeing to it that all new machinery is equipped with Fast's Couplings. Start now by replacing (before it breaks down again) the most troublesome drive in your plant—and prove what Fast's Mechanical Flexibility means.





Two spur gears, one on each shaft end, are completely and continuously meshed in oil with the internal gears of a floating sleeve. The shafts and sleeve revolve noiselessly as one unit, allowing free angular and lateral movement.

Send for Free Book by an authority



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Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Aviation

AIRCRAFT PROPELLERS, by Lieutenant Commander C. H. Havill, is a rather technical explanation of the procedure to be followed in selecting propellers of the detached blade type for use on various types of motors. This paper was awarded the Wright Brothers' Medal as the best treatise on aerodynamics, structural theory, or design, presented before the Society during 1928. *Society of Automotive Engineers, 29 West 39th Street, New York, N. Y.—Gratis.*

REPORT OF THE AIRWAY MARKING COMMITTEE, of the Aeronautics Branch of the Department of Commerce, presents the requirements for airway marking, with recommendations for a standard system to be used throughout the country. *Aeronautics Branch, Department of Commerce, Washington, D. C.—Gratis.*

HOW BUSINESS USES AIR TRANSPORTATION reveals that 96 percent of all banks, insurance companies, and business concerns located on airmail and air-transport routes make use of these services. The paper gives the result of a questionnaire sent to representative buiness firms to ascertain the status of airmail in commercial practice, and includes a summary of airmail time tables with a skeleton map of the United States showing the routes now in use. *U. S. Chamber of Commerce, Washington, D. C.—Gratis.*

Agriculture

APPLES, Bulletin Number 34, presents data regarding commodity prices in their relation to transportation costs. The bulletin shows various price phases incident to marketing apples, from producer to consumer, with freight rates from principal producing areas to representative markets. *Bureau of Railway Economics, Transportation Building, Washington, D. C.—Gratis.*

THE ANGORA GOAT AND MOHAIR INDUSTRY Miscellaneous Circular No. 50 of the Department of Agriculture, explains the improvement of the goats and their fleeces as a result of the expansion of the mohair industry in this country. *U. S. Government Printing office, Washington, D. C.—30 cents.*

Construction

TAKING THE MYSTERY OUT OF LUMBER BUYING explains in understandable language the meaning of American Lumber Standards, and simplifies lumber-buying for people who have no technical knowledge of lumber grades. This booklet introduces to the public the new practice of grade-marking the end of each board with a stamp showing the quality of the product. *National Lumber Manufacturers Association, Transportation Building, Washington, D. C.—Gratis.*

PRESERVATIVE CHEMICAL TREATMENT FOR MINE TIMBERING, by Dr. A. M. Howald, explains the technique of wood preservation with special reference to railroad ties and mine timbering. *Mellon Institute for Industrial Research, Pittsburgh, Pa.—Gratis.*

MINIMUM REQUIREMENTS FOR PLUMBING is the title of a report of the Plumbing Committee, of the Department of Commerce, regarding plumbing problems of "skyscraper" construction. This analysis of plumbing in high buildings is supplementary to a study made several years ago in connection with installations in dwellings and small buildings. *U. S. Government Printing Office, Washington, D. C.—35 cents.*

Electricity

ELECTRIFICATION is the title of an attractive booklet describing the electrification of the New York Central Railway lines. The booklet includes several pages of engineering data, and numerous photographs of exteriors and interiors of plants and equipment, with six wiring diagrams. *General Electric Company, Schenectady, New York.—Gratis.*

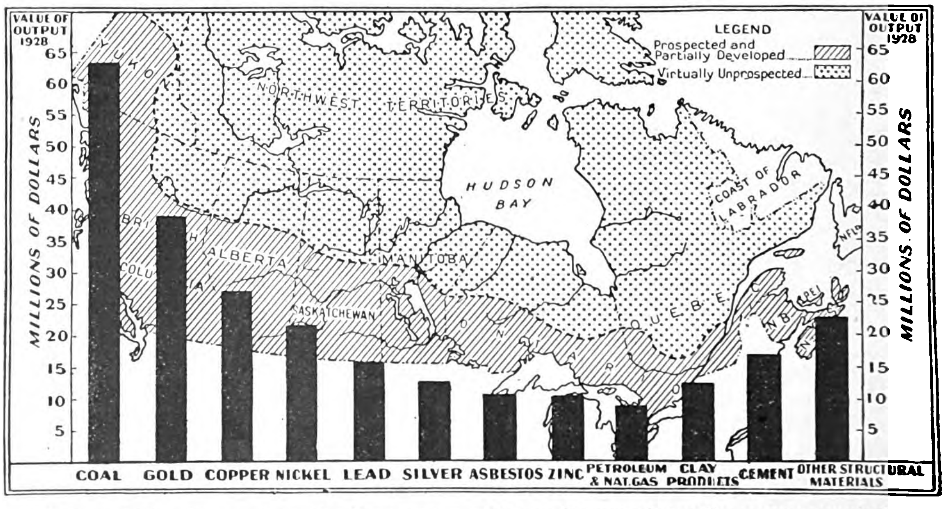
THE POWER MONOPOLY, ITS MAKEUP AND MENACE, by Gifford Pinchot, shows an array of facts of considerable interest, whether or not one agrees with the deductions of the author. The tabulations show that six banking and investment groups, through 35 holding companies, control about 64 percent of the country's electrical power and serve about 68 percent of the population. However, approximately the same situation prevails in the steel industry, where six producers control more than two thirds of the output. Those who want to know where a company is located, or the profits of a certain holding company, or similar facts, will find the book a convenient reference. *Gifford Pinchot, Milford, Pa.—Price not announced.*

STUDY OF ELECTRIC LIGHT AND POWER SERVICE, by Samuel S. Wyer, presents information relating to present-day power service for acquainting the public, through the schools and other agencies, with the fundamental problems of fuel and power. The paper shows the various phases of production, transmission, and use of electricity, and is intended to clarify the disputed question of electric power. *Fuel-Power-Transportation Educational Foundation, 1116 Beggs Building, Columbus, Ohio.—Gratis.*

Geology

MODERN METHODS OF MEASURING THE INTENSITY OF GRAVITY, Special Publication Number 69 of the U. S. Coast and Geodetic Survey, gives detailed instructions for all of the operations required in the measurement and computation of the intensity of gravity. Oil geologists and others engaged in the study of geophysical problems will find this publication of value and interest. Attention is also called to Special Publication Number 23, which is issued gratis, describing the various activities of the Coast and Geodetic Survey. *U. S. Government Printing Office, Washington, D. C.—15 cents.*

THE SCOPE OF CANADA'S MINERAL FIELD, shows the steady ascent of Canada's mineral production in late years, the importance of the Dominion as a field for mineral industry, and the remarkable variety of



Although large areas in the Dominion of Canada are virtually unprospected, the immense value and variety of her mineral resources indicate that Canada's mining industry is assured a stable and well sustained era of development minerals that enter into the annual output. *Bureau of Statistics, Department of the Interior, Ottawa, Canada.—Gratis.*

Metallurgy

CHROMIUM PLATING PROGRESS, by W. M. Phillips and M. F. Macaulay, includes a short summary of the advancement made during the last 10 years in the methods of plating with copper and nickel, and a discussion of the development and advancement of chromium plating. *Society of Automotive Engineers, 29 West 39th Street, New York, N. Y.—Gratis.*

CADALYTE, A PROCESS AND PRODUCT FOR CADMIUM PLATING, is a descriptive booklet dealing with the development and application of cadmium in the production and fabrication of iron and steel. The properties of the metal, and its advantages as a rust-protective agent, are effectively presented. *The Grasselli Chemical Company, Inc., Columbus, Ohio.—Gratis.*

ROASTING OF LEAD-CARBONATE ORES PRELIMINARY TO GRAVITY CONCENTRATION includes a detailed explanation of the new method of roasting low-grade lead-carbonate ores that have been formerly considered without commercial value. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

Miscellaneous

ABSTRACTS OF SCIENTIFIC AND TECHNICAL PUBLICATIONS from the Massachusetts Institute of Technology indexes important articles and books on a wide variety of scientific subjects. Each item is briefly but capably reviewed. *The Technology Press, Cambridge, Massachusetts.—Gratis.*

A COMPARATIVE STUDY OF WORLD WAR CASUALTIES FROM GAS AND OTHER WEAPONS presents the case for instruments of chemical warfare, in an attempt to dispel the common prejudice against poison gases. Quotations from "The German War Book" are cited in substantiation for the contention that the most dangerous and most massive means of destruction are really the most humane. The booklet is a valuable treatise on the subject of chemical warfare, especially concerning poison gases. *U. S. Government Printing Office, Washington, D. C.—35 cents.*

A SHORT METHOD OF CALCULATING NUTRIENTS IN THE DIET, Technical Bulletin No. 105 of the United States Department of Agriculture, includes a review of early food investigations, food surveys of American families, usual methods of calculating energy and nutrients of the diet and improved short methods of value. A good bibliography on the subject is included. *U. S. Government Printing Office, Washington, D. C.—Five cents.*

ANTHRACITE SIZES FOR DOMESTIC USE, by R. H. Fernald, presents the results of an extensive research to determine the relative economic values of various types of fuel in house heating equipment and in cooking ranges. *Towne Scientific School, University of Pennsylvania, Philadelphia, Pa.—Gratis.*

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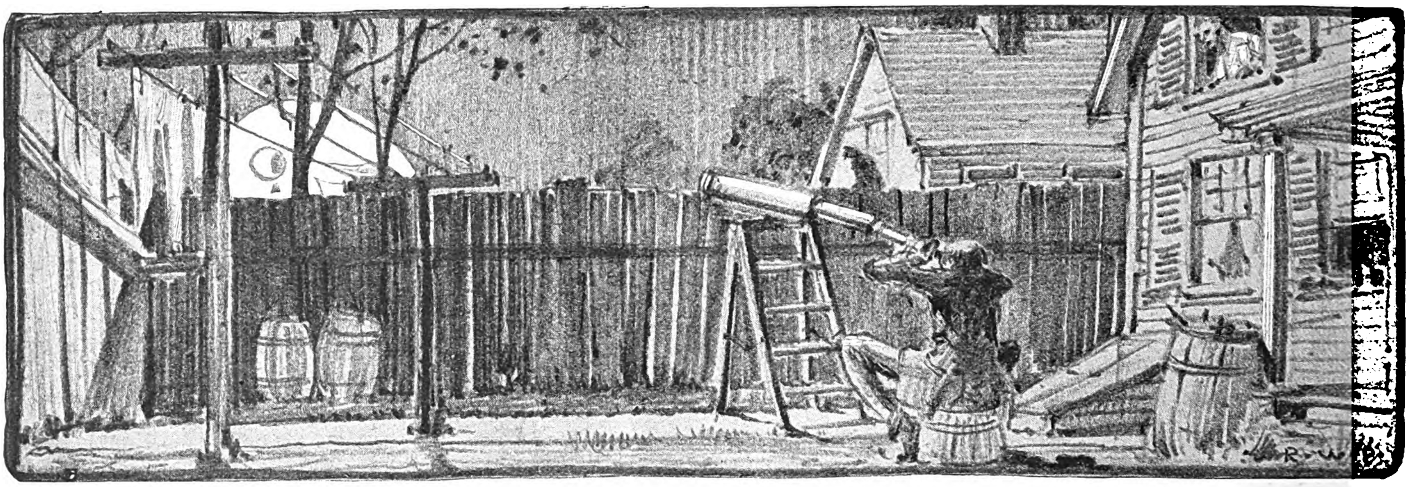
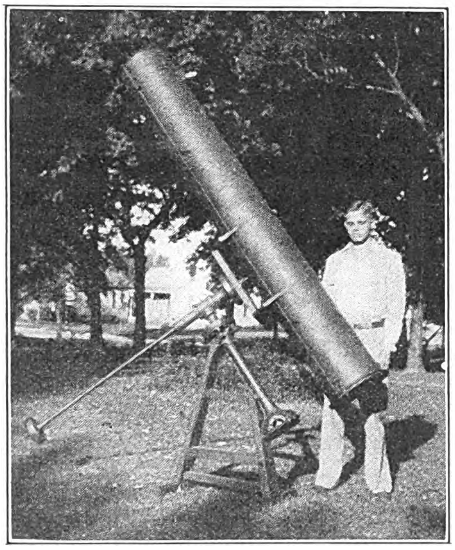


The Amateur Astronomer

MR. THOMAS RHODES, 1721 Eighth Avenue, South, Fort Dodge, Iowa, sends us the following communication—

"It has been two years since my curiosity was sufficiently aroused to send for your instruction book 'Amateur Telescope Making.' Since that day much of the time that I could spare from attending high school has been spent upon the fascinating business of grinding and polishing mirrors.



Mr. Rhodes and his 12-inch telescope. Notice the polar axis

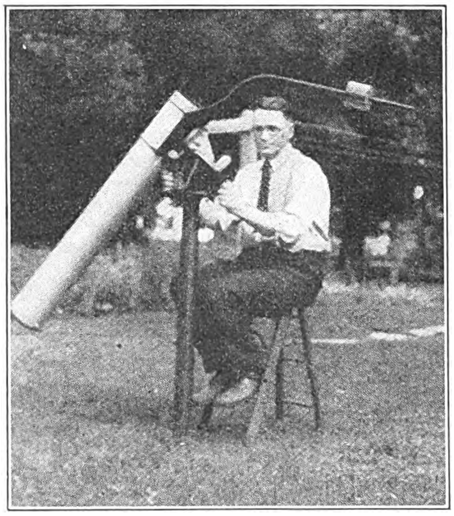
"My first attempt was a mirror of six-inch aperture and 50-inch focal length. The greatest difficulty encountered was the inability to construct a perfect pitch lap. However, the mirror was parabolized in due time, and mounted. The results were very satisfactory, as the telescope gave beautiful definition of all celestial objects which I was able to pick up.

"After finishing my first mirror I decided to construct a larger instrument which would have an equatorial mounting provided with setting circles. This mirror is 12 inches in aperture and 96 inches in focal length. It is a considerably larger job than the earlier one, but the results are far superior.

"It required 18 hours to grind and polish the mirror, and many more to produce the required correction. To my great surprise the silvering proved to be the most obstinate problem of the entire process, although I had experienced no trouble silvering my first mirror. It cost five dollars for materials and much worry and study before the desired degree of success was obtained. (An average experience. Silver is fickle.—Ed.)

"The mounting is of the conventional design of Mr. Ions. This was adopted because it could be constructed with very little machine work. A portable mounting should be as light as possible, and for this reason I constructed the counterweight on an extension of the declination axis, which permitted the use of a comparatively light weight and enabled the mounting to be more easily moved. This telescope gives perfect definition and shows a beautiful image of Saturn or Jupiter.

"I have doubly profited by my experiences as an amateur telescope maker. The construction of the mirror itself was so intensely interesting that I would feel repaid if there was no result other than the production of a perfect paraboloidal curve. But I have also been admitted into the wonders of the heavens. Before I constructed my first telescope I neither knew nor cared anything for astronomy. I now spend many evenings in exploring the sky, and although I do not know much about the movements of the celestial bodies as yet, I am diligently studying the science and hope to learn more."



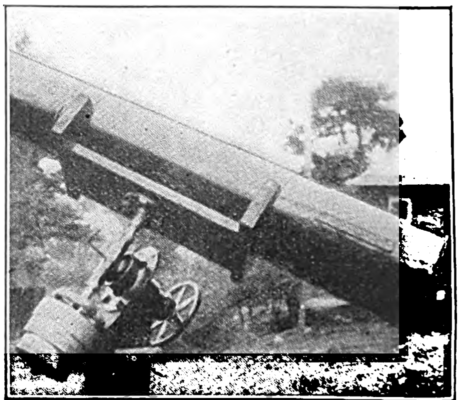
Mr. King and his six-inch reflector

Mr. E. T. King, 301 West Lincolnway, Jefferson, Iowa, sends us a photograph of his six-inch telescope. This is the Springfield type. His method of supporting the polar axis, as shown in the illustration, is unique.

What the average newspaper reporter will do is, of course, beyond scientific, or even unscientific, prediction. One Des Moines Sunday paper states that Mr. King can now sit in his back yard and "speculate what forms of civilization the moon and stars have"! Still, this is little worse than a claim made by one of our readers—a telescope maker, at that—who is certain that he sees volcanic eruptions on Capella! He also claims he sees vegetation and what-have-you! He does not seem satisfied with our suggestion that he clean his eyepiece and read up on the theory of resolving power. The sun is the only star on which even the most powerful telescope will reveal detail; or, in fact, even the actual disk itself.

Mr. P. O. Parker, Cohutta, Georgia, is the first to make use of a Ford *front* wheel assembly for a polar axis. He writes: "I enclose a photograph of my telescope which was made according to the instructions in the book 'Amateur Telescope Making.' I had quite a bit of trouble figuring the six-inch mirror, but finally got a fair job. With eyepieces of one inch, one half inch and one fourth inch it gives excellent results on the moon and planets, and fairly good on double stars.

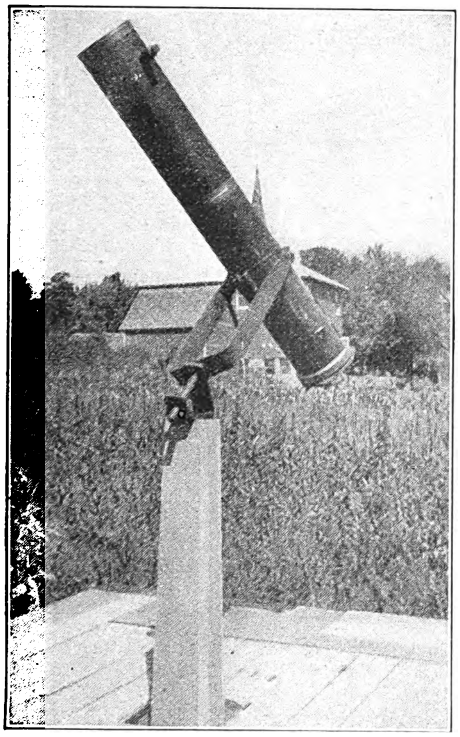
"The mounting was made from a Ford front hub assembly. The upright was cut at proper angle for latitude, and hub bolted to it for polar bearing. The spindle acts



Mr. Parker's Ford wheel mounting

as declination bearing. The declination axis was the only part requiring any machine work, and it very little. The counterweight was moulded of babbit. The wheel just above the counterweight is a declination clamp. A four and one half dollar worm and gear from the Chicago Stock Gear Works, whose advertisement appears in each issue of the SCIENTIFIC AMERICAN, made an excellent slow motion in right ascension. The entire mounting and work cost about ten dollars."

This front hub assembly stunt impresses us as an ingenious arrangement. It provides a fitting funeral for a model T Ford.

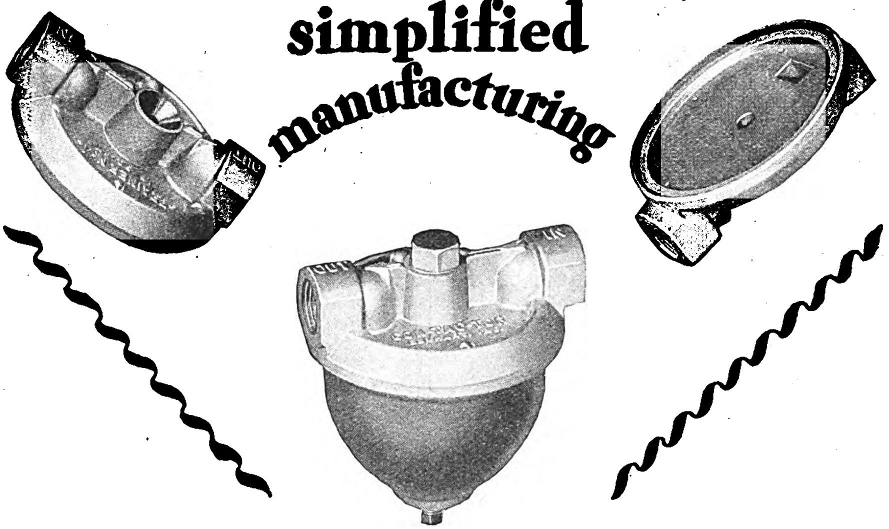


A six-inch fork type mounting made by Frank Murray, 404 Mission St., St. Marys, Kansas. The extended fork permits view of the celestial pole. On large sizes the overhang might cause flexure and vibration, as it is quite extensive

Dr. J. J. Byl, 430 South 13th Street, San Jose, California, writes that he is experimenting with lunar photography, using the telescopes he described in the issue of last February, on page 177. As others are no doubt doing the same thing it is hoped that a number of photographs of the moon will be sent in for publication in some one issue. Another issue will be devoted to spectroscopes, providing enough photographs of those made by amateurs reach us within a few months. Next month's space will be devoted largely to grinding and polishing machines made by amateurs.

This month we have altered the standard heading of our department from "The Back Yard Astronomer" to the form you see at the top. This does not, however, mean we have become too "high hat" to inhabit the back yard during our observation periods; in fact, we have retained Porter's sketch of the typical back yard with all the trimmings. "The Amateur Astronomer" gives us a little more scope and dignity—as if we needed that quality!

We are making a collection of the inevitable misprints and errors found in A. T. M., as it is desired to compile an erratum sheet. We therefore request those who have found any such slips to advise us, as



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Agents Wanted in this Section

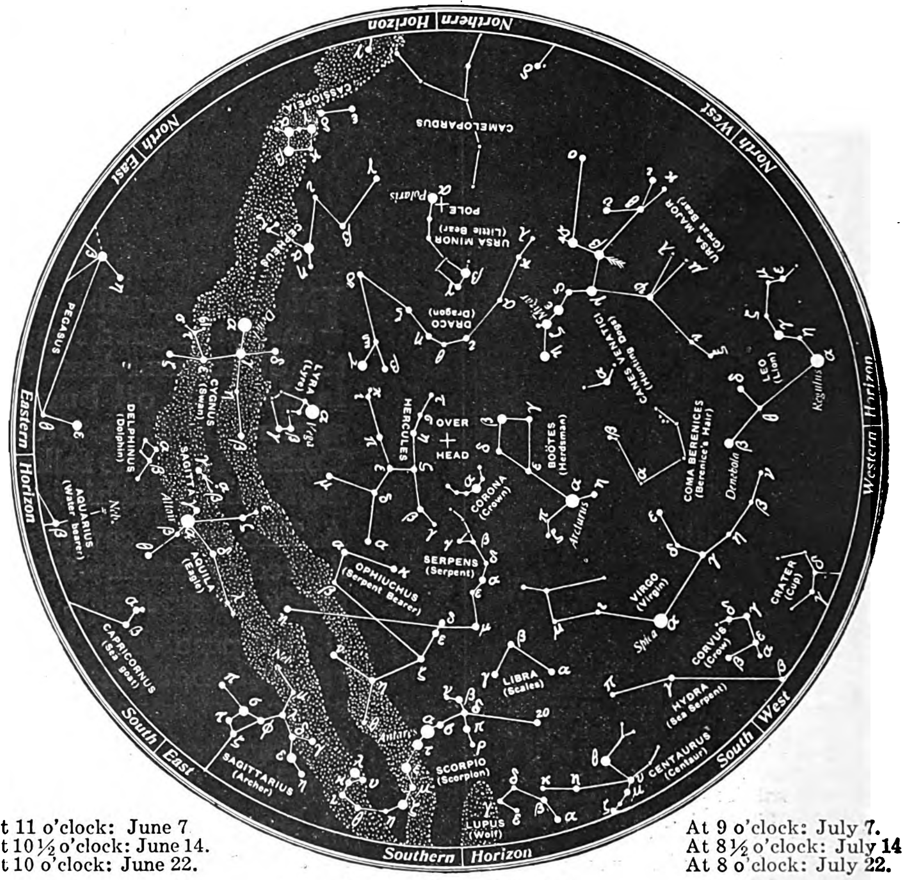
there are doubtless some which we have missed.

Amateurs in Pittsburgh have been organized into a club which meets on alternate Sundays at the homes of the different members. The president of this club is Chester B. Roe, 624 Hemlock Street, Avalon, Pennsylvania.

Now that Old Man Winter is off the job, Young Man Mosquito is on. The amateur astronomer is beset with troubles the year around—unless he happens to live in California or places where neither nuisance exists. Ye Tel. Ed. undergoes two annual changes of mind in this regard: in summer, when slapping the famous Jersey mosquito between short peeps at the eyepiece, he thinks there will at last be peace when cold weather comes; but in cold weather he must slap still harder to prevent death by freezing. Maybe, after all, the best place to be is down cellar, making more telescopes to try out later and discover that the cold or the mosquitoes render it advisable to retreat to the cellar and make another telescope to . . . Well, why *do* we amateurs make telescopes, anyway?—*A. G. I., Tel. Ed.*

The Heavens in June

By PROF. HENRY NORRIS RUSSELL, Ph.D.


Northern Horizon
North East
North West
Eastern Horizon
Western Horizon
South East
South West
Southern Horizon
CASSIOPEIA
CAMELOPARDUS
Polaris
POLE
URSA MINOR (Little Bear)
DRACO (Dragon)
URSA MAJOR (Great Bear)
CANES VENATICI (Hunting Dogs)
LEO (Lion)
Regulus
PEGASUS
CEPHEUS
CYGNUS (Swan)
LYRA (Lyre)
Vega
DELPHINUS (Dolphin)
HERCULES
OVER + HEAD
BOOTES (Herdsman)
Arcturus
CORONA (Crown)
COMA BERENICES (Berenice's Hair)
Denebola
AQUARIUS (Water bearer)
SAGITTA
Altair
AQUILA (Eagle)
SERPENS (Serpent)
OPHIUCHUS (Serpent Bearer)
VIRGO (Virgin)
Spica
CRATER (Cup)
CORVUS (Crow)
CAPRICORNUS (Sea goat)
LIBRA (Scales)
HYDRA (Sea Serpent)
SAGITTARIUS (Archer)
Antares
SCORPIO (Scorpion)
LUPUS (Wolf)
CENTAURUS (Centaur)

At 11 o'clock: June 7.
At 10½ o'clock: June 14.
At 10 o'clock: June 22.
At 9½ o'clock: June 30.
At 9 o'clock: July 7.
At 8½ o'clock: July 14.
At 8 o'clock: July 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on June 7, etc.

NIGHT SKY: JUNE AND JULY

MERCURY is an evening star at the beginning of June, but is too near the Sun to be observable. On the 18th he passes through inferior conjunction and becomes a morning star. By the end of the month he is well visible rising before 3:30 A.M.

Venus is a morning star and very brilliant. She rises about 2:30 A.M. on the first and just before 2 o'clock on the 30th (by standard, not by daylight saving, time).

Mars is an evening star setting between 10 and 11 P.M. He is now nearly 200 million miles away and is not very bright.

Jupiter is a morning star rising nearly two hours later than Venus when the month begins, but only half an hour later at its close.

Saturn is in Sagittarius and comes to opposition on the 19th. Since at this date the Sun is very close to the northernmost point of his track in the sky, Saturn is close to his southernmost. He is nonetheless conspicuous and outshines considerably any star in the southern sky.

Uranus is a morning star in Pisces, and Neptune an evening star in Leo—both poorly placed for observation.

The moon is new at 9 A.M. on the 7th; in her first quarter just after midnight on the 14th; full at 11 P.M. on the 21st; and in her last quarter at 11 P.M. on the 29th. She is nearest the earth on the 8th and farthest away on the 22nd. During the month she passes Uranus on the 2nd, Venus on the 4th, Jupiter on the 6th, Mercury on the 7th, Mars on the 11th, Neptune on the 12th, Saturn on the 21st, and Uranus again on the 30th.

At 5 P.M. on June 21st the Sun reaches its greatest northern declination and in the old almanac phrase "Summer commences."

The Scientific American Digest

(*Continued from page* 542)

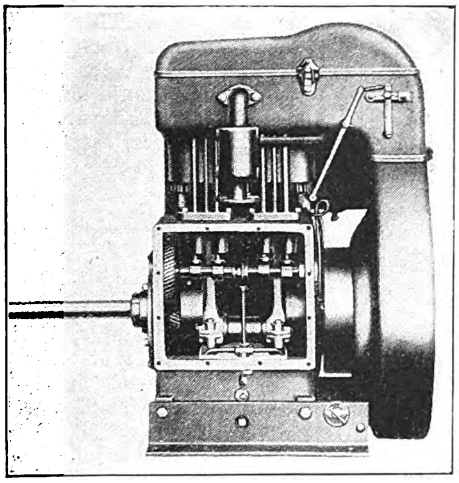
chinery for industrial plants, theaters and public gathering places all over the country, some of his most recent being the Capitol at Washington, the Paramount and Roxy theaters and the National Broadcasting Studios in New York City. It was logical that Mr. Carrier would direct his efforts toward developing a home "Weather-maker" for producing conditioned air, and this has now been designed. The cooler air, which collects near the floor of the house, is drawn down through return air grilles into ducts connected with the "Weathermaker" unit in the basement. Here the air is scrupulously cleaned by passing through filters comprising fine mesh wire, like a steel wool, covered with a viscous material which acts as a barrier to dust particles and the germs carried by them. It is then caught up by a motor-operated rotary blower and forced through a series of heating sections which are heated by gas fuel. The air is next humidfied by passing over a humidifier capable of evaporating several gallons of water a day and is then distributed into every room of the house through ducts connected to register openings in each room. This process goes on continuously and is under automatic control as to temperature and humidity.

From the humidifying chamber, air is circulated through the house under pressure, but not forced sufficiently to cause a draft. It goes evenly to every room, and windows need not be opened at any time.

Scientists claim that by maintaining sufficient moisture by evaporation, a home may be kept comfortable at from two to seven degrees lower than usual.

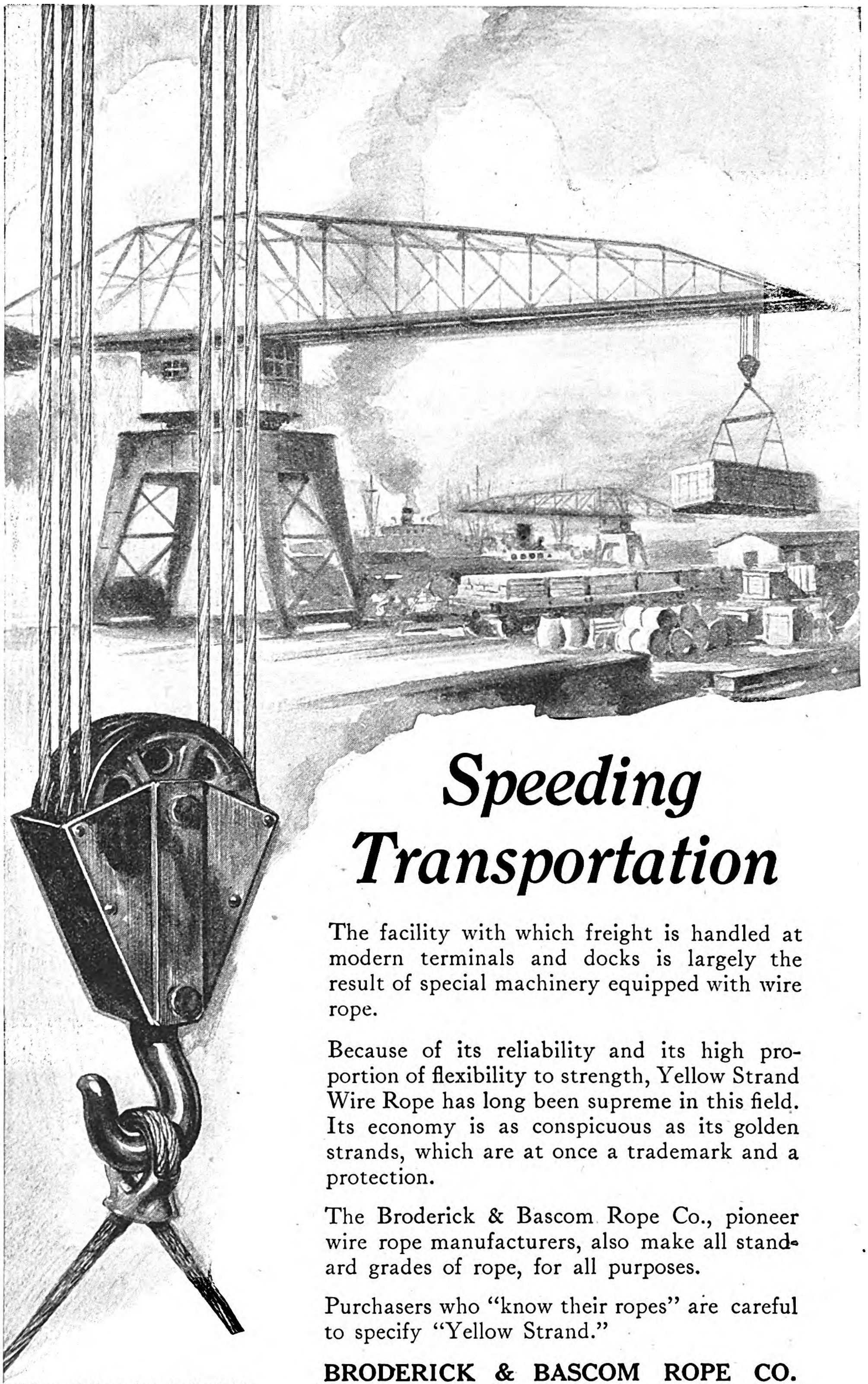
Air-cooled Industrial Gasoline Engine

IN 1905 the first air-cooled engine was developed for industrial and foreign use by The "New-Way" Motor Company of Lansing, Michigan, and for 23 years this company has consistently stood by its conviction that the air-cooled engine would eventually come into its own and the possibilities of light weight together with simplicity of construction would force a recognition of this type of engine for certain classes of work which could not be satisfactorily handled by a water-cooled engine.



Small air-cooled gasoline engine rated at six to ten horsepower

There is no question regarding the ability of air-cooled engines to deliver satisfactory



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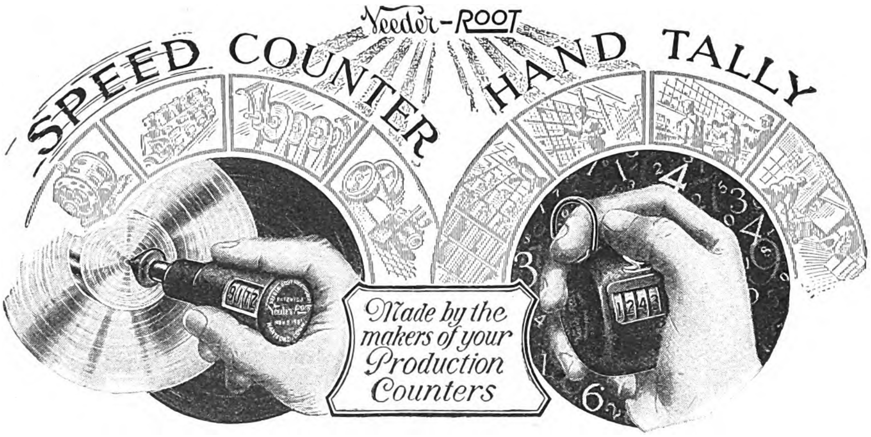
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service; in fact, the latest and highest type of power, aircraft motors, may be said to represent the last word in mechanical knowledge, and the seal of approval affixed to air-cooling by aircraft engineers settles for all time the debate on water versus air-cooling.

In the new twin-cylinder six to ten horsepower engine, announced recently, there are no water pipes, radiator fins, or other parts necessary to water-cooling. It is a valve-in-head type with detachable cylinder head. A large inspection plate may be removed, exposing all moving parts. A distinctive feature is the ease with which pistons may be removed and replaced through the inspection-plate opening. Roller bearings, air-governor, Eisemann special flywheel magneto, Tillotson float feed carburetor and air cleaner, and Lynite connecting rods are standard equipment on this new engine.

The flywheel is provided with a series of curved blower blades around its periphery, and as it turns it creates a partial vacuum in the wheel housing. The strong suction effect draws air in and down through the cylinder jackets. The air currents pass over and between the flanges at fairly high velocity, and as there is a large amount of exposed surface, the excess heat is promptly disposed of, being absorbed by air passing around the cylinders, which is ejected from the motor compartment by the action of the blower flywheel.

Insulating L. O. X.

An unusual instance of the help received in one field of scientific progress by the advancement at the same time in another occurs in the development of the explosive L. O. X. and the part insulation has played in making this product available commercially.

L. O. X. consists of finely divided carbon, such as lamp black, put into cheese-cloth bags and soaked with liquid oxygen. Because there is no ash, and because the carbon and oxygen combine to form harmless carbon dioxide gas, this was apparently an ideal explosive. There was, however, one seemingly insurmountable difficulty in making it a success for mines and quarries where small liquid oxygen plants were to be installed. It was necessary, after putting the carbon cartridges in an insulated chest on wheels, to fill the chest with liquid oxygen and to saturate the cartridges. No insulation, however, was found which had enough efficiency to prevent the evaporation of the liquid oxygen, the temperature of which is 293 degrees below zero.

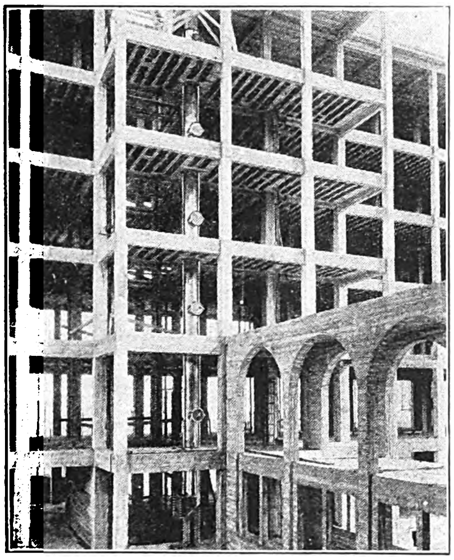
Those interested in this explosive, after repeated tests, discovered that Dry-Zero insulation, itself a recent scientific achievement in the insulation field, when used to insulate the chests proved 100 percent more efficient than any other material used, and since the adoption of this insulation for this purpose, L. O. X. has progressed rapidly and successfully.

Soiled Linen Chute in Hospital

Sanitary methods of handling soiled linen in hospitals is now recognized as an essential feature in properly protecting patients and employees. The installation of an aluminum soiled-linen chute was made at the N. H. D. V. S. Hospital at Sawtelle, California, and extends for the length of six stories as shown in the accompanying photograph.

A sheet aluminum throat is furnished for the intake at each floor and is extended through the partition wall to the door jamb casting outside the wall. The door consists of a cast aluminum ring, set with wire glass center, closing against a rubber gasket. The hinge is a heavy pin through strong lugs cast as parts of the door jamb and door casting, and the door is forced tight against the gasket by a refrigerator door clamp.

At the bottom, very rigid construction and heavy reinforcement give ample strength for deflection of bags of laundry by a slanting bottom to the side discharge. A steel leg is provided for supporting the bottom of the chute.



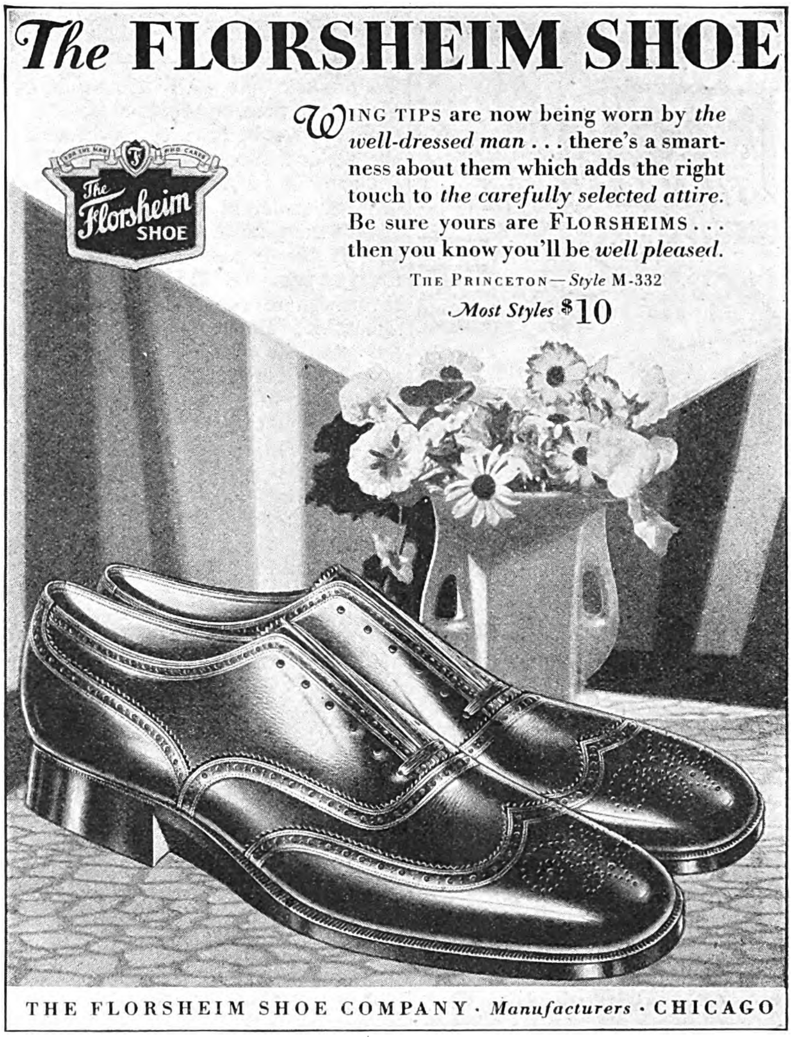
Concrete skeleton of hospital, showing the soiled linen chute

The use of aluminum in the construction of the soiled linen chute allows for cleansing with the flow from a spray pipe or with disinfectants applied with a long-handled brush inserted at intake openings. Furthermore, aluminum does not rust.

Nobody Can Make it Rain, Says Weather Bureau

SOME years ago a man went through certain drought-stricken regions in this country contracting to produce an inch or more of rainfall for a consideration of 1000 dollars per inch within a period of three months. If the rain came, the fees were collected; if it did not, the man lost nothing. Inasmuch as the average amount of rainfall for each region is accurately recorded, and since precipitation is quite likely to occur naturally after a long drought and within the limits of the record, a shrewd operator is fairly safe in agreeing to "produce" rain.

But according to the Weather Bureau of the United States Department of Agriculture, "rain making" is impossible for any human being. It is quite true that in the laboratory a small amount of moisture can be precipitated by using special equipment, but meteorologists know of no practical scheme for producing rain on a large scale. Widespread drought is due to lack of sufficient moisture in the atmosphere and the absence of other conditions essential to the formation of rain. If there is little moisture to bring down, obviously no device for causing rainfall has



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any value; moisture cannot be "manufactured."

Looking at the matter another way: To produce one inch of rainfall over an area of an acre, approximately 113 tons of moisture would have to be drawn up into the air and then precipitated! There are 640 acres in a square mile, for which 72,320 tons of moisture would be required. A square mile, however, would be scarcely a dot in the center of any section where drought prevails. It would be less than one seventieth of the area of the District of Columbia. Enormous quantities of energy are used in nature to elevate moisture above the earth before it can be precipitated. It takes 5,000,000 to 10,000,000 horsepower-hours to evaporate the water in a square mile of the average dense cloud, and even if some artificial means were found to cause the aggregation and fall of the infinitesimal drops of which rain is made up, calculation shows that only a trifling amount of precipitation would result, because there is not much water in a cloud.

Wanted: Cure for Forestry Problem

PRIZES of 1000 dollars and 250 dollars have been offered by the Society of American Foresters, 930 "F" Street, N. W., Washington, D. C. for the best essays describing the present forestry situation and proposing a nation-wide remedy for its solution. The contest closes in September.—*Science Service.*

Adhesive Tape Wrapping Stops Serious Tree Ills

ORDINARY adhesive tape, used for emergency mending on everything from a cut finger to a punctured tire, proves to be the long-sought means for saving millions of young trees in nurseries from crowngall, root-knot, and similar malformations. The discovery was made by Professor A. J. Riker and his associates, of the University of Wisconsin.

The germs of crowngall and similar tumorous diseases of plants, which have caused heavy losses for years in the nursery business, get into newly made grafts through the freshly cut surfaces which are normally supposed to grow together in a smooth union. The usual types of wrapping used on grafted trees fail to keep them out. But an overlapped wrapping of adhesive tape excludes them effectively and permits success with over 90 percent of all grafts made, Professor Riker reports. —*Science Service.*

"New Navigation Tables for Mariners and Aviators"

A SHORT and quick method of working problems in celestial navigation which gives a rapid and accurate method of finding the position for ships as well as of planes, has recently been published by the Hydrographic Office, Navy Department, under the above title. It is so small in size as to be easily carried in a side coat pocket and so handy and simple to use that a navigator in a small life-boat can find his position as accurately as if he were on a high-speed ship with a library of navigation books at his disposal.

These tables will probably supersede all the old ones now in use because of utility, simplicity, and accuracy of results, for aviators, submarine officers, yachtsmen, and navigators of all small craft. All that

HOW

can you solve your intimate personal problems of happiness and unhappiness? How can you overcome bad habits? How do you get the impulse to steal, to murder? How can your emotions make you ill? How much of your brain do you use? How does your job fit you? How can you be happy though married? In short, How do you get that way?

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don't your parents understand you? Why don't you make more money? Why do you have headaches? Why can't you help taking a chance? Why are there so many celibates, divorces, mismated couples? Why do you sleep so much? Why do you fall out with people? Why do you fall for some people and not for others? In short, why aren't you the happiest person alive?

WHAT

holds you back from your desires in love and work? What is the cause of suicide? What was the matter with your school teachers? What might cause your marriage to be unhappy? What causes frigidity in women? Father love? Mother love? Jealousy? Temper? Tears? What should every new-born have? What should every mother know? What is wrong with your mind? In short, what makes you the way you are?

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will find the answers to these and thousands of other intimate personal questions in the great new book HOWS AND WHYS OF HUMAN BEHAVIOR, by the famous doctor and scientist, George A. Dorsey. 500,000 people read his best-seller WHY WE BEHAVE LIKE HUMAN BEINGS, and thousands of them wrote to him asking him the questions they could not ask their family physicians, questions about the things they hid from the world. In this great new book, he will tell you WHY your life has not been what you hoped for, and HOW to get the things you want in life. Sign the coupon now, mail it today, and the book will come to you for five days free examination. Then, if you do not find thousands of helpful suggestions, return it to us and it has cost you nothing.

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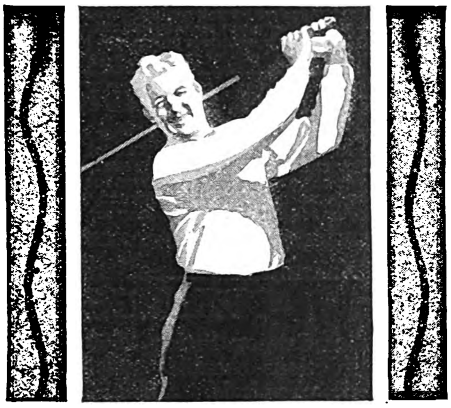

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PAL is far superior to the ordinary all-elastic supporter. It is porous . . . knit of soft-covered elastic threads. A more *efficient* supporter . . . snug where it should be . . . comfortable all over. PAL doesn't get perspiration-stiff . . . doesn't chafe. At all drug stores . . . one dollar. (*Price slightly higher in Canada.*)

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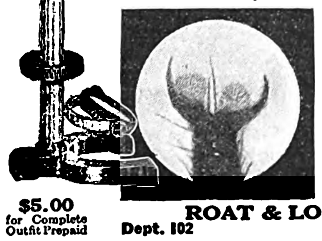

At last a high powered microscope is within the means of all who wish to study, observe and experiment with the vast world of minute objects invisible to the naked eye. Such fun it is, as well as educational. No technical training required, yet hundreds of scientists and teachers are using this instrument. Gives enormous magnification and perfect definition. Send $5.00 for complete outfit. Send for descriptive literature.

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is required in addition is the Nautical Almanac, a sextant, and a watch. The Nautical Almanac is the publication of the United States Naval Observatory which gives the celestial co-ordinates of the heavenly bodies as used by navigators.

Aviators herald the publication of this book because the space in an airplane is so limited that hitherto it was often impossible to carry the larger and heavier books in the cockpit. Thus many have been known even to attempt sea flights without the proper navigation tables, trusting to luck or sense of direction to lead them to their destination.

The formulae upon which the tables are based, were deduced and the method evolved by Lieutenant Commander J. Y. Dreisonstok, U. S. N., while a member of the Naval Examining Board when he realized the trouble young navigators had with the old, long, and tedious methods of solving the astronomical triangle, and their dread of logarithms. So he was later attached to the Division of Nautical Research in the Hydrographic Office, where he completed the calculations and put them into the present form.

For utilization of this method one must, of course, know the rudiments of navigation. A background such as given in H. O. Publication number 9, "The American Practical Navigator" by Bowditch, makes it very simple, for this is not a text book on navigation, but *tables* for the use of navigators and aviators.

The method of solving navigational problems is applied without variation to all problems regardless of the position of the heavenly body, be it sun, moon, planet, or star. It requires few figures and gives a quick solution for determining (a) line of position, (b) compass error, (c) medium altitude, (d) great circle course and distance, and (e) identification of unknown stars. The precision of the tables is within 0.′ 1.

While a small and handy size book is desirable, space is given at the end to a full explanation of the construction of these tables together with numerous problems in order that an opportunity for analysis may be afforded those who desire to investigate their soundness and use.

The tables extend from 0 degrees to 65 degrees in latitude, but the Hydrographic Office has prepared for the special use of Commander Richard E. Byrd, U.S.N., tables for latitudes up to and including 90 degrees. With the extension of the tables, a navigator can pilot his ship or plane from the equator to the poles.

Down-Stairs "Skyscraper" Planned for Tokyo

THE child's conception of things in the Orient being topsy-turvy is upheld by a Japanese project for a downstairs "skyscraper," 80 stories deep. This building, which would be built down into the earth 1100 feet, is designed in defiance of earthquakes.

This world's deepest building is planned for Tokyo, where earthquake proof architecture has been a serious problem ever since the disastrous quake of 1923. Designs for the building are in the form of a huge circular well of steel framework. Elevators, ventilating airshafts, telephones, and electric lights are provided for. The cost is set at about 11,000,000 dollars. The Shin Nippon Construction Company is interested in the project.—*Science Service.*

Did You Ever Take An INTERNAL Bath

By M. Philip Stephenson

This may seem a strange question. But if you want to magnify your energy—sharpen your brain to razor edge—put a glorious sparkle in your eye—pull yourself up to a health level where you can laugh at disease and glory in vitality—you're going to read this message to the last line.

I speak from experience. It was a message just such as this that dynamited me out of the slough of dullness and wretched health into the sunlit atmosphere of happiness, vitality and vigor. To me, and no doubt to you, an Internal Bath was something that had never come within my sphere of knowledge.

So I tore off a coupon similar to the one shown below. I wanted to find out what it was all about. And back came a booklet. This booklet was named "Why We Should Bathe Internally." It was just choked with common sense and facts.

What Is An Internal Bath?

This was my first shock. Vaguely, I had an idea that an internal bath was an enema. Or by a stretch of the imagination a new-fangled laxative. In both cases I was wrong. A real, genuine, true internal bath is no more like an enema than a kite is like an airplane. The only similarity is the employment of water in each case. And so far as laxatives are concerned, I learned one thing—to abstain from them completely.

A bona fide internal bath is the administration into the intestinal tract of pure, warm water, Tyrrellized by a marvelous cleansing tonic. The appliance that holds the liquid and injects it is the J. B. L. Cascade, the invention of that eminent physician, Dr. Charles A. Tyrrell, who perfected it to save his own life. Now here's where the genuine internal bath differs radically from the enema.

The lower intestine, called by the great Professor Foges of Vienna, "the most prolific source of disease," is five feet long and shaped like an inverted U—thus ∩. The enema cleanses but a third of this "horseshoe"—or to the first bend.

The J. B. L. Cascade treatment cleanses it the entire length—and is the only appliance that does. You have only to read that booklet—"Why We Should Bathe Internally" to fully understand how the Cascade alone can do this. There is absolutely no pain or discomfort.

Why Take An Internal Bath?

Here is why: The intestinal tract is the waste canal of the body. Due to our soft foods, lack of vigorous exercise and highly artificial civilization, nine out of ten persons suffer from intestinal stasis (delay). The passage of waste is entirely too slow. Result: Germs and poisons breed in this waste and enter the blood through the blood vessels in the intestinal walls.

These poisons are extremely harmful. The headaches you get—dizziness—the bad odor of perspiration—the sluggish responsiveness of both mind and body—failure to get most out of life and many other conditions are directly due to the presence of these poisons in the system. They are the generic causes of high blood pressure, rheumatism and other serious maladies.

Thus it is imperative that your system be free of these poisons. And the only sure and effective means is internal bathing. In fifteen minutes it flushes the intestinal tract of all impurities. And each treatment strengthens the intestinal muscles so the passage of waste is hastened.

Taken just before retiring, you will sleep like a child. You will rise with a vigor and satisfaction that will insure your doing all the strenuous things your friends will want to do.

Just one internal bath a week will remake glorious vibrating health. That is not my experience only. It is the experience of over 900,000 men and women.

Send for this Booklet

It is entirely FREE. And I am absolutely convinced that you will agree you never used a two-cent stamp to better advantage. There are letters from many who achieved results that seem miraculous. As an eye-opener on health, this booklet is worth many, many times the price of that two-cent stamp. Use the convenient coupon below or address **Tyrrell's Hygienic Institute, Inc., Dept. 476, 152 West 65th Street, New York City.**

Tyrrell's Hygienic Institute, Inc., 476
152 West 65th Street, New York, N. Y.

Send me, without cost or obligation, your illustrated booklet, "*Why We Should Bathe Internally*" on intestinal ills and the proper use of the famous J.B.L. Internal Bath.

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Chemistry in Industry

(*Continued from page* 553)

types. Today over 100 domestic oil heaters are sanctioned by the fire underwriters.

Copper, mainly in the form of its alloy, brass, is used for approximately 100 parts of the various assemblies in the several types of equipment. As much as 25 pounds of brass is used in some types of domestic apparatus, with an average of ten pounds of brass and two of copper. Some models of industrial equipment use 50 pounds of brass, and average 17 of brass and three of copper.

The present rate of development in the oil-heating industry points to a copper consumption totalling seven million pounds per year in the production of parts for oil heaters.

Chemistry and the "Bright Lights"

"A FEW years ago it seemed impossible that a gas so rare that only one part occurs in every ten thousand parts of air could have the effect on advertising that has developed through the better knowledge of the properties of neon gas," says Joseph H. O'Neil, writing in a recent issue of *Chemical and Metallurgical Engineering.* "The most obvious results of the development of neon, argon, and helium are glowing colored tube electric advertising displays and signs that dot the avenues of all the larger American cities.

"These gases occur in exceedingly small concentrations, neon –0.001 percent, argon –0.93 percent and helium –0.0005 percent. This readily indicates to those who are familiar with gas extraction processes that their extraction from the air requires a highly developed technique.

"They are customarily recovered as a part of the process of the rectification and separation of air for the production of oxygen and nitrogen.

"For the purpose of advertising displays, the gases are inclosed in glass tubes containing an electrode at each end, the gas acting as the conducting medium. The electrodes are cylindrical in shape and made of copper. A lead glass is generally used for the tubing, since it is easiest to work. After the tubing has been bent into the desired design and the electrodes sealed in, it is evacuated as far as possible with Langmeir and Eisler pumps. To drive all air out of the electrodes and walls of the glass tubings the electrodes are bombarded by means of a current at 16,000 volts. This is repeated three times to remove the last traces of air, which must be absent before introducing the gases.

"The tubes are then cooled to room temperature and the gases are introduced. This is accomplished by sealing the tubes in a line in which are the reservoirs of neon, helium, or argon and a pressure gage. The gas or gasses, depending upon whether a single gas or a combination of gases is desired, is or are then allowed to flow into the tube until a desirable pressure is obtained. The pressure varies with the different gases, in the case of neon a final pressure of over seven and one half millimeters is used, while twice that pressure is desired in the case of other gases.

"The tubes are then removed from the line and further purified by 'aging.' This process consists of applying a low voltage and requires from five or ten minutes to 24 hours, depending upon the length of

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Big demand for 5 and 10c store Novelties, Ashtrays, Toy Soldiers, Animals, Auto Radiator Ornaments, etc. We cooperate in selling goods you make; also buy these from you. Small investment needed to start and we help you build up. We furnish COMPLETE OUTFITS and start you in well-paying business. Absolutely NO EXPERIENCE and no special place needed. A chance of a life-time for man with small capital. Write AT ONCE if you mean strictly business and want to handle wholesale orders now being placed.

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time required to bring an entire tube to a uniform color. It is at this point that the mercury is added if desired and distributed throughout the length of the tube. The tube is then ready to be put in place on the metallic framework of the sign.

"The various colors are obtained by using individual gases, combinations of gases and mercury vapor, and colored glass. Almost any color and tone can be produced by these means. The colored glass most generally used is a yellow lead glass. The most generally used of all the colors is the orange red, which is a white glass tube containing neon; yellow or golden is yellow glass containing helium; green is the yellow glass tube containing neon and mercury vapor; blue light is secured primarily from vaporized mercury, mixed with either neon, argon, or some other gas. Lavender, white, and other lights are possible from mixtures of various rare gases."

Corrosion Proofing Gives Dark Colored Surface

REPORTS of a new corrosion-proofing process come from Germany. It is known as the Jirotka Immersion Process. This procedure consists in dipping the articles to be treated in solutions of complex metallic salts, as of cobalt, nickel, and manganese. These solutions vary in composition according to the object in view. In most cases there is a subsequent treatment in galvanic baths.

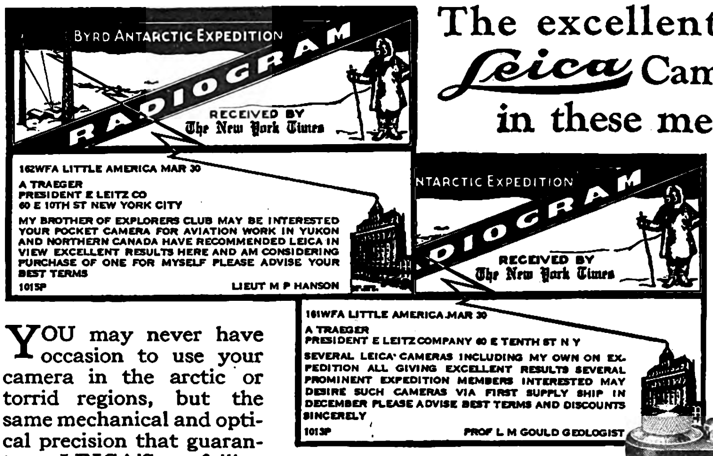
This process is particularly useful for automobiles, airplanes, illuminating equipment, and the like, which thereby acquire a permanently attractive appearance and become corrosion-proof. The coatings produced by the Jirotka process do not have a metallic character but resemble ebony or are mahogany colored and are distinguished by their great variety of color shades. The process has proved particularly successful for the treatment of light metals, especially aluminum.

Banana Vinegar!

"BANANA oil" has an established place both in the lacquer trade and in current slang, but now we are introduced to banana vinegar. Mr. Harry von Loeseke describes its manufacture in a recent issue of *Industrial and Engineering Chemistry*.

Banana vinegar has been successfully made on a laboratory scale. Color, aroma, and taste were pleasing. The method of production was to make a mash from the pulp and peel of ripe bananas, pasteurize at 75 degrees, Centigrade, for 45 minutes, cool, and inoculate with a pure culture of *Saccharomyces ellipsoideus*. After vigorous fermentation began (about three days at 20 to 23 degrees, Centigrade) this mash was used as a starter for a larger quantity of pasteurized mash.

The pasteurization is necessary because banana mash abounds in acetifying bacteria, which must not be allowed to act in the early stages of the process. Acetification was effected by trickling the fermented liquor over beechwood shavings which had been boiled in water, and dried and soaked in strong vinegar; but control of air supply was too difficult in the small laboratory apparatus. Better results were obtained by the Orleans process, in which the fermented juice is brought to a suitable acidity for bacterial acetification by addition of strong vinegar.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1013P PROF L M GOULD GEOLOGIST

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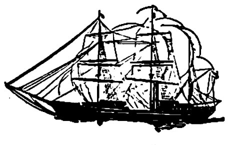

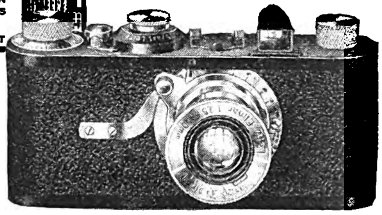

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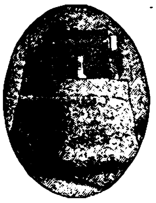

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Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

State Royalty Tax Held Illegal

INCOME from royalties derived from patents or copyrights issued by the United States government are not taxable under the state personal income tax law of New York, according to a recent ruling based on a decision of the United States Supreme Court. The decision is based on the case of Long *versus* Rockwood, in which the Supreme Court held that a state may not take royalties from United States patents or copyrights for the reason that such taxation would involve interference with functions of the government.

Considerable discussion in legislative circles has resulted from the decision, for if the ruling is retroactive, it may result in demands from many authors and inventors for refunds from income tax payments made on royalties received in the past. Taxes have been collected by the state on royalties, some of which are reported to have amounted to hundreds of thousands of dollars.

Other states having royalty taxes on incomes from patents and copyrights will be in the same positon as the state of New York, if the decision is judged retroactive. In that event, a flood of demands for refunds may be expected from authors and inventors who have paid taxes illegally.

Process for Breaking up Oil Emulsions Denied Patent

DESPITE the fact that the oil industry is now burdened annually with some 2,000,000 barrels of intimately mixed oil and water, which apparently cannot be separated despite repeated attempts and years in storage, a practical method of separating the liquids into strata has been adjudged no novelty.

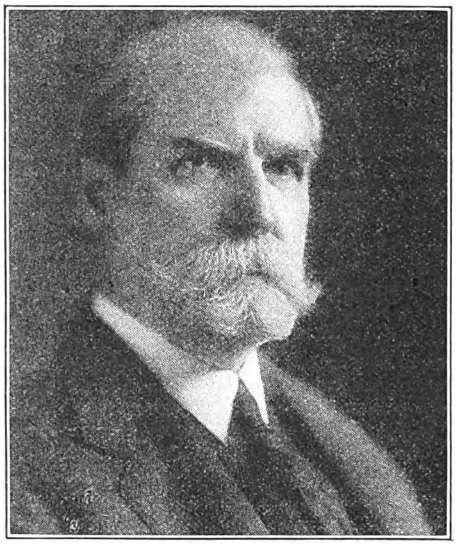
A patent was issued January 29, 1929, to Samuel Warren Cole for a process of recovering oils from emulsions. The decision of the Examiner rejecting certain claims covering such a process was confirmed on appeal. The Board stated that there was nothing inventive involved in the process, which dehydrates the emulsion by means of a chemical reagent combining with the water and breaks up the emulsion, allowing the oil to be recovered.

The invention relates to a process for treating natural crude petroleum with a chemical, calcium carbide or sodium, in such a way as to release a small fraction of the water surrounding minute globules of oil or water in a film, so that the emulsion is broken up into strata. Heat may or may not be used in the process, and the chemical used may combine with the water in the emulsion to produce heat, which reduces the viscosity of the oil and materially aids in the precipitation of the water.

The Board of Appeals of the Patent Office held that there is nothing inventive involved in the process, and that the same process, carried forward to generate an indefinite quantity of acetylene gas insufficient to completely dehydrate the emulsion, is utilized in patents on record. The references relied upon are: De la Roche, May 30, 1899; Benkendorf, January 23, 1912; Schreiber, February 7, 1922; and Vittenet (France), July 25, 1903.

Charles Evans Hughes Addresses Patent Attorneys

HUMBLY confessing his trepidation at appearing before "the assembled erudition of the Patent Bar," the Honorable Charles Evans Hughes recently addressed the New York Patent Law Association at its annual dinner in New York City, where he was the guest of honor. Mr. Hughes, who has been awarded the greatest honors the world can bestow upon its jurists, commented on the incomprehensible language used by patent attorneys, and the fascination and importance of their work.



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Judge Charles E. Hughes, America's foremost jurist, of the Supreme Court and the World Court

Answering those critics who complain about the law's delays, the distinguished jurist called attention to the delays of legislatures in effecting solutions to even the simpler problems. The long struggle to secure an adequate number of judges in certain localities was mentioned, with the trenchant comment, "We may have debates over what the law ought to be, but there should be no serious conflict of opinion in providing the judicial machinery to enable suitors to invoke the laws we have."

It was pointed out that, "there were pending in the Southern District of New York, on the civil side of the court, 2270 cases in admiralty, 2154 in law, and 861 in equity. It was estimated that it would take two years to reach an admiralty case for trial, and 18 months to go to trial in law and equity. In addition, there is the work of the criminal and bankruptcy parts and the motion calendar. The six judges of the district court cannot perform this work. They are under the greatest pressure in mind, body, and estate. Judges from other districts have been brought here to help them out."

Touching on the importance of selecting judges for the Federal courts with the utmost discretion, the guest of honor said, "The solicitations and intrigues of politics should have no place. Character, learning, experience, and tact are the qualifications for the Bench. The best guarantee of fitness is sound professional reputation. The prestige of the Bench is largely dependent on the distinction of those who are appointed to it, and it should always be remembered that a good judge is the community's most important asset."

Dr. Georges Claude Discusses Invention

SKETCHING the fundamental principles underlying success in research and invention, the distinguished French inventor, Dr. Georges Claude, sets up a number of helpful guide posts for others who may be possessed of an inventive turn of mind. In an article entitled, "Ideas of An Inventor," which appeared in a recent issue of *The Tech Engineering News* (Massachusetts Institute of Technology), Dr. Claude presents the essence of the inventive philosophy. His own contributions to science include the discovery of acetone as a solvent for acetylene, processes for liquefying air and for the fixation of nitrogen, and the familiar Claude neon light tube. Like most inventors, he enthusiastically declares that his present work is to be his greatest achievement. Perhaps he is justified, for he can claim to be on the verge of harnessing the almost limitless energy of the ocean to run turbines.

"There are many persons who believe that the more science advances and the more industry progresses, the less remains to be invented," Dr. Claude declares in commenting on the field for invention. "On the contrary," he continues, "every new resource, every new invention, is able to combine with some of the other existing possibilities to permit many other combinations. This is not a question of opinion or feeling, it is an absolute, mathematical certainty; so that contrary to the opinion just mentioned, we ought to believe that our power of realization increases constantly, quickly, and indefinitely—the rapidity of modern progress is nothing other than the confirmation of this fact.

"But if the first need of an inventor is an absolute and solid confidence in the innumerable resources placed at his disposal by nature and science, it does not follow that he can use them without discrimination. Getting the result needed from a thing or a substance poorly fitted for that purpose is no longer worthy of science, when it is probable that far better things or substances or combinations can be found to suit that purpose in the immense and ever growing arsenal of the properties of matter and energy. In that respect, we may venture to say that it is probably heresy for us to do a single thing now as it was done a century ago.

“It follows from all this that, in my opinion, the difficulty of an inventor is not to make an invention, but to choose from among the multitude of inventive ideas which strike his mind the one which is really worth while. This is all the more so since the achievement of a small invention frequently proves to be as difficult as that of a greater one. . . . It follows, further, that for any problem, a simple solution only is worth considering. A rule to which I tie my mind the best I can—for an inventor’s mind is a fiery steed which often leads its master where he would prefer not to go—is to stray from the usual paths, in the simple belief that the less frequented is the way, the greater are the chances of meeting unknown and important things. This, of course, is not invariably true; many times interesting inventions are made in the most explored fields. But the probability of making important discoveries is better in less explored fields.”

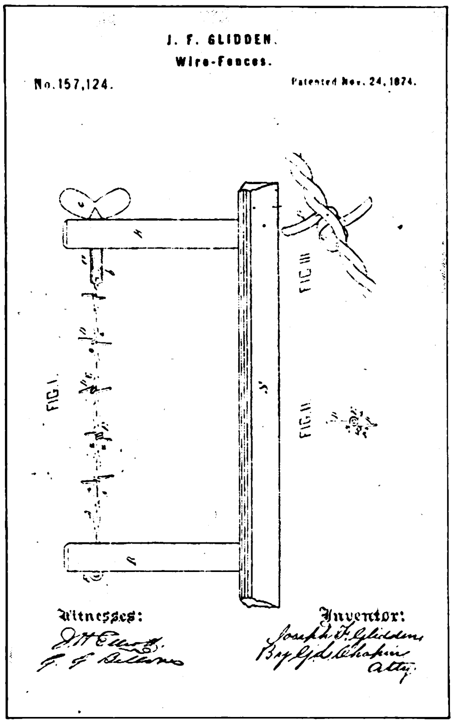
However, Dr. Claude recognizes the inherent obstacles in pursuing such a course. “I agree that this way is not without some serious drawbacks,” he says. “It may happen, for instance, that proceeding along a new road one may make such an advance as compared to that which has been done before, that the result obtained does not correspond to an existing need, or appears so fantastic to those engaged in ordinary pursuits that one is kindly advised to take a rest in some lunatic asylum. If you are inclined to find in these friendly remarks excitement and pleasure rather than discouragement, then all is for the best.”

No finer example of this is found than in Dr. Claude’s own work. His early research in connection with dissolved acetone, liquid air, oxygen, and hydrogen, led finally to the utilization of the rare gases, particularly neon. From 1907 to 1913 Dr. Claude patiently developed his process for neon lighting. His long wait for recognition of its importance is best expressed in his own words.

“It happens, as I said before, that too new a question often pays for its novelty by having no existing need. And, this time, my hopes narrowly missed failing and the starting of neon lighting was very difficult. It was in Pittsburgh, at the Congress of the Illuminating Society of 1913, that I presented, for the first time in America, my neon tubes. The tubes I showed on this occasion were exactly like the present tubes as to their shape, their sizes, the intensity of their light. However, I could not succeed in arousing interest in them. Soon after came the war—and this matter of neon lighting had to wait until recent years before finding its way into America.”

Speaking of his latest occupation, the development of thermic energy from the sea, Dr. Claude explains the basis for the common conclusion that among our present unemployed sources of energy, only solar heat is worthwhile. Apparently Dr. Claude and his colleague, M. Boucherot, originally held the same thought, for it was while engaged in solar research in the Sahara desert that the plan for utilizing the thermic energy of the ocean was conceived.

Even in the torrid regions of the desert one could not hope to get steam under pressure, in the common sense of the word. “However,” explains Dr. Claude, “You know that water easily boils at any temperature below 100 degrees, Centigrade, in a boiler under reduced pressure from which the steam is continually removed as fast as it is produced by the suction of a condenser in which this steam is condensed by colder water. This steam, under a pressure of one atmosphere, can very well run a turbine on its way to the condenser. When thinking one day of the remarkable fact that deep sea temperature is everywhere, even in the tropics, near the freezing point, while the tropical sea surface water remains uniformly above 25 degrees Centigrade, an idea occurred to me that I should have considered foolish had it not been for this progressive training. The idea was that a difference in temperatures as great as 25 degrees and 4 degrees, Centigrade, would be sufficient to produce steam, to condense it, and to move turbines 24 hours a day and from the beginning to the end of the year.”



Cattle damaged the crops of Joseph F. Glidden. His patent on barbed-wire made him a millionaire

Although appearances were far from encouraging, certain accepted formulae showed this hypothesis to be theoretically correct. With the aid of his young cousin, Andre Claude, he built a small turbine to test out the theory, and to their delight, the turbine ran at full speed. But then came a flood of criticism and argument, much of it from eminent specialists. “In short,” Dr. Claude states, “it was a complete smashing of our proposals, for in spite of the past of both Boucherot and I, there were very few who, like your SCIENTIFIC AMERICAN, admitted that if this proposal could startle engineers, our past achievements ought to make them give us credit.

“So strong was this opposition—so true is it that objectors are too often the wreckers of progress—that I stopped all my efforts to organize a company, and decided not to go ahead before having proved our ideas at my own expense. This proof was given at Ougree in Belgium, in which a turbine of 60 kilowatts was successfully driven at 6000 revolutions per minute by the action of a difference of temperature of 18 degrees Centigrade. I have now but to prove that the difficulties of the installation at the sea are equally open to solution. For that purpose, I plan to have my Ougree plant transported to Cuba, where these ideas have met with the most cordial response, and to connect this plant with the cold depths by a convenient pipe as soon as I have ascertained the submarine currents, temperatures, and depth conditions in the vicinity of Havana, which I am now doing. After that I shall probably be in a position to pass to the realization of the first of our industrial plants, which shall be a 12,000 kilowatt installation.”

Improving the Patent Law System

FROM time to time one hears rumors to the effect that the patent system of the United States is not perfect. No one denies that it has some good points, but many suggestions for its improvement have been made by both competent and incompetent critics of the system. Announcement has recently been made that a prize of 1000 dollars is to be awarded for the best essay or monograph on the subject, “A Complete Program for the Improvement of the United States Patent Law System.”

The Faculty of Law of Northwestern University presents the announcement, as follows:

“The sum of 1000 dollars and a bronze medal, as a first prize, and two sums of 100 dollars each, as second prizes with honorable mention, will be awarded to the authors of the best essays or monographs submitted by March 1, 1930.”

The award will be made by vote of the Faculty of Law; to be eligible for the award the author must be a member of the bar or a student registered in a recognized law school, or a patent agent in the United States of America, or in any other country of Anglican law. The Faculty reserves the right to make no award if in its judgment no work submitted is of sufficient merit. The first prize award will not be divided, but provision is made to enable the Faculty to make honorable mention of as many as two meritorious contributions not receiving prizes. The award will be made public in June, 1930, on the occasion of the annual meeting of the Alumni Association of the Law School. Details of the competition may be obtained from The Linthicum Foundation, Northwestern University Law School, McKinlock Campus, 357 East Chicago Avenue, Chicago, Illinois.

The contest is for the Linthicum Foundation Prize, which is awarded annually, when the contributions merit an award. The subject for the award in 1927 was “The Law of Radio Communication,” and the prize was awarded to Stephen Davis, formerly Solicitor to the United States Department of Commerce. No award was made in 1928. The subject for the award of 1929 is “Scientific Property,” and the prize will be awarded at the annual meeting of the Alumni Association of the Law School in June.

Change of Jurisdiction in Patent Appeals

ATTENTION is called to the fact that the newly-created Court of Customs and Patent Appeals will be governed, in so far as patent appeals are concerned, by the provisions of the revised rules which went into effect on April 1st. All patent and trademark cases that were pending in the Court of Appeals of the District of Columbia have been transferred bodily to the new court. For the present, at least, the new court will follow the Rules of Procedure of the Court of Appeals of the District of Columbia, in so far as they relate to patent appeals.

Attorneys who are not members of the bar of the Court of Customs and Patent Appeals will have to arrange for admittance. This may be done either on motion of a member of that bar, or upon recommendation of a Federal judge or of a judge of the highest court of any state. Nonresident members may be admitted from time to time in the usual way, either on motion by an attorney of the court in open court, or by a letter of recommendation of a judge. A nominal admission fee is charged upon entry.

Patent Awarded Improved Paper Cup

FOR some time there has been a demand for paper drinking cups that will withstand the comparatively high temperatures of beverages such as coffee and hot chocolate. A patent has been awarded for a cup that is claimed to withstand temperatures of at least 150 degrees, Fahrenheit, utilizing a single layer of paper impregnated with a mixture of paraffin and carnauba wax. The carnauba wax is present in sufficient proportion materially to raise the melting point of the mixture, so that the cup is not quickly destroyed by the presence of hot liquids.

Another feature of the new paper cup is that there is no wax on the outside of the cup or on the rim. One trouble with the present type of paper cup has been a tendency to soil the hands or gloves of one handling it, and also a rather objectionable taste or odor. The waterproofing is applied only to the interior of the cup, under the new patent, and is substantially odorless and tasteless when in use.

James D. Reifsnyder, who was awarded the patent for impregnated paper drinking cups as described above, was also granted a patent on an apparatus for separating paper cups in a dispensing device. The Reifsnyder apparatus for dispensing nested cups makes use of a flange at the open end of the cup, and a cam for prying the flanges of the two lowermost cups apart. It was held that former patentees had not anticipated or contemplated the prying process for forcibly separating such cups, although one of them showed means of forcibly separating the lowermost cup from the stack by a pulling action on the body of the cup.

Another inventor, who discovered a method of making paper cups over 15 years ago, has recently been in court seeking to punish for contempt a former employee alleging that the employee had betrayed his secret process, in defiance of a court order secured by the inventor 14 years ago forbidding the employee to use or disclose the process. The inventor had not patented his invention, preferring to keep the process a secret.

The court was impressed by the circumstance that the inventor had waited for several years without applying for patents, and that the former employee had made proper application. It was held that the inventor was wrong in standing idle while his secret was being revealed in the Patent Office, and that he should have made his claim of wrongful use when the former employee sought the protection of the established agency of the Government. The motion for punishment was denied, the judge holding that the judgment of prohibition did not put a straitjacket on the ex-employee's brain. He was not required to abandon the inventive turn of mind although its exercise involved the use of the knowledge he had acquired in the inventor's shop.

Novel Coal Trademark Allowed

REVERSING the examiner's ruling, Assistant Commissioner Moore has allowed the registration of a trademark consisting of a combustile orange-colored disk bearing the words "Orange Disc," to be scattered among lumps of loose coal. The examiner's holding that the mark was merely a label or tag of a single color was overruled, and a distinction made between form or color of marks, and form, size, or color of articles to which they applied.

A label or tag identifies the goods; a trademark identifies the originator or owner of the goods, according to the ruling of the Assistant Commissioner. The applicant's mark does not identify the goods, for as there is no such thing as orange coal, or disk coal, or orange disk coal. The applicant's mark meets every requirement of a valid trademark, being arbitrary, fanciful, and non-descriptive of the goods.

In commenting on the decisions cited by the examiner, the Assistant Commissioner held that they merely decide the obvious fact that a label of a single color, apart from any name, figure, or device with which it may be connected, may not be the subject matter of a trademark. Otherwise any other person who might adopt a label having a similar color for the same class of goods would be chargeable with unlawful imitation.

Extended Research Wins Recognition

CLAIMS regarding the originality of an apparatus for promoting certain chemical reactions were sustained on the grounds that the invention was a product of many experiments and long research, in a recent infringement suit in which the validity of the patent was questioned. In the case of the Barrett Company *versus* the Seldon Company, the District Court for the Western District of Pennsylvania ruled that the patent held by the Barrett Company was valid and infringed by a similar apparatus designed to accomplish the same result.

The decision was based upon a finding that the patentee used materials and principles well known to those versed in chemical reactions, but that he combined them in such a way that a new and valuable result was obtained, as evidenced by the fact that the apparatus was completed only after numerous experiments and long pursuits of the basic ideas, and that the Seldon Company had replaced its apparatus with the type of device covered by the patent. The court ruled that the validity of the patent was established, and that since the defendant's apparatus embodied the essential ideas of the plaintiff's patent it constituted an infringement.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Anyone desiring official copies of patents listed in this section, at 15 cents each, (state patent number to insure receipt of desired patent copy), or the address of a patentee, may obtain the same by addressing Munn and Company, Patent Attorneys, 24 West 40th Street, New York City.

Pertaining to Apparel

UNDERGARMENT—A form-fitting garment with every sanitary requirement, which will serve as the sole necessary undergarment for warm weather, except where a slip must be worn with very sheer dresses. Patent 1705399. Eva J. Goldenblum.

Chemical Processes

TREATMENT OF FELT AND FELT HAT BODIES—Particularly for increasing the lustre, and the firmness of velour felt hat bodies, by a 20 to 30% aqueous solution of meradole or like synthetic tanning agent, at a temperature of 60–80 centigrade. Patent 1705437. Erick Bohm.

Designs

DESIGN FOR A WHEELED TOY—Patent 77781. Edward W. Lawson.

DESIGN FOR A TELEPHONE CABINET—Patent 77865. George H. Supplit.

DESIGN FOR A DRESS—Patent 77974. David Minchenberg.

DESIGN FOR A DRESS—Patent 77739. Katherine E. Burns.

DESIGN FOR A SHOVEL—Patent 77900. Edward W. Lawson.

DESIGN FOR A DRESS—Patent 77986. Mildred C. Schmolze.

DESIGN FOR A TEXTILE FABRIC OR SIMILAR ARTICLE OF MANUFACTURE—Patent 77953. Herman Haug.

DESIGN FOR A NOSE BRIDGE FOR A SPECTACLE FRAME—Patent 77793. Vincent Tanasso and Jacob J. Pomeranz.

DESIGN FOR A GOBLET OR SIMILAR ARTICLE—The inventor has been granted three patents on ornamental designs, 77942, 77943, and 77944. George Dougherty.

DESIGN FOR A VENDING BOOTH—Patent 78010. James T. Crow.

DESIGN FOR A NOSE BRIDGE FOR SPECTACLE FRAME—Patent 78131. Vincent Tanasso and Jacob J. Pomeranz.

DESIGN FOR A COAT—Patent 78115. Dorothy Long.

DESIGN FOR A DRESS—Patent 78116. Dorothy Long.

Electrical Devices

ELECTRIC CONTROL SWITCH—Adapted to be secured at the upper end of a vertically disposed handle and conveniently operated by the thumb for controlling two circuits, so that either may be opened or closed. Patent 1703724. Clarence C. Crispen.

Radio Communication System—Which reduces interference from atmospheric or other causes, and uses a single carrier wave to transmit a number of different messages or programs at the same time. Patent 1703719. Roy B. Bryant.

Electric Water Heater—So constructed that when, for any reason, there is no water in the tank, the thermostatic control will automatically open the circuit, and prevent the heating element from burning out. Patent 1705417. Charles F. Rogers.

Electrical Winding—A conducting wire so wound that it functions to reduce to a minimum re-radiation and interference, increases selectively and sensitivity, and aids in maintaining the allotted frequency of a broadcasting circuit. Patent 1705396. Francis De Willy.

Terminal Insulation Cover—For stripped or unraveled electrical conductors, may be quickly applied and will have a very neat appearance, tensionally holding itself in position. Patent 1705159. John H. Rouse.

Time-Controlled Apparatus—Which permits the use of a conventional clock for automatically starting or discontinuing, at a predetermined time, a radio receiving set, or may be adapted to use on a phonograph. Patent 1705985. Reuben W. Lovering.

Of Interest to Farmers

Separator—For separating cream, the milk tank being constructed with a faucet and a notched bottom rim, so that when turned it will be raised above the edge of the supply funnel. Patent 1704658. John Degerth.

Of General Interest

Milk Bottle Crate—Including a hollow body with end walls, side walls, and partition members, held together by metal cross rods, adopted to hold milk bottles either for deliveries or for washing. Patent 1703733. Henry A. Hamilton.

Concrete Pile—Having an upper formation for resisting driving blows, and an increased lateral frictional surface to resist any loosening tendencies, and thereby lend stability to the pile when driven. Patent 1703817. Charles E. Fowler.

Method of Making Imitation Marquetry, Parquetry, Inlays, etc.—Whereby an effect is obtained on a single surface of a variety of different woods, each separate section being so stained as to prevent the discoloring of any surrounding sections. Patent 1703746. James A. O'Neill.

Lawn Sprinkler—Whereby horizontally disposed nozzles are so arranged as to turn the sprinkler parts about a vertical axis, due to the reaction of the water escaping to the air. Patent 1704610. Fred I. Jaden.

Oil Can—Of the usual diaphragm bottom type, with mechanism whereby a predetermined quantity of heavy oil may be discharged irrespective of the position in which the can is used. Patent 1704573. William G. Matthews.

Ventilator—So constructed that it may be readily attached to or detached from the inside of an ordinary window sash without in any way marring the sash frame or molding strip. Patent 1704578. Fred J. Rennert.

Method of and Apparatus for Conserving Cocoons of Silk-Producing Insects—Comprising a chamber for subjecting the cocoons to chilled air, thus arresting the development of chrysalide to moth form, yet preserving the silk providing filament in an unbroken perfect state. Patent 170972. Glenn D. Hurst.

Safety Razor — Comprising a specially formed blade holder, intended for use with well known single-edge razor blades, but which prevents the accumulation of lather and cut hair, and facilitates shaving operations. Patent 1074591. Edwin L. Connor.

Compact Holder—Wherein a retractile holding element is provided normally acting to substantially lock the compact in place, but permit the release thereof at any time. Patent 1704616. William G. Kendall.

Container Stopper—In the form of a disk of balsa wood, which will not affect the color or flavor of the liquid stoppered, for use with metal crowns or caps. Patent 1705445. Kurt R. Gitterman.

Coffee-Making Apparatus—In which the coffee liquid contained in the coffee receptacle may be caused to siphon from the receptacle through coffee grounds by merely moving a single valve. Patent 1704809. George P. Petropulos.

Window Screen—A frame, part of which is permanently secured, and part disengageably connected to a window frame, and means associated therewith for maintaining a strip of netting under continuous tension. Patent 1705442. Franklin Dominick.

Curtain Stretcher—Including a rectangular self-supporting framework which may be conveniently set up, accurately squared, and readily adjusted to accommodate curtains of various widths and lengths. Patent 1706283. Charles M. Flink.

Pipe - Closure - Forming Device — Which may be quickly formed at the end of a pipe without the necessity of welding, and will withstand any ordinary pressure to which the pipe would be subjected. Patent 1705864. Percy Jackson.

Piling—A hollow pile through which a refrigerant may be circulated to freeze wet or infirm earth in which the pile is embedded whereby it may be better worked. Patent 1704577. Edmund S. Pomykala.

Plate-Glass Holder—So constructed that they may be readily assembled for holding panels of glass in place on the top of and along the marginal edges of a display counter. Patent 1706345. Charles Bleakley.

Metal-Molding Apparatus—A flask which is very compact and requires a relatively small amount of sand in casting iron sash weights or similar articles, especially effective where quantity production is desired. Patent 1706305. Charles H. Lyne.

Bag Holder and Display Rack—Composed of a plurality of units of different sizes adapted to be arranged in superimposed relation, with means for readily selecting the bag required by sliding movement. Patent 1706307. Theodore P. McCarthy.

Combination Scraper, Blade Sharpener and Corn Cutter—Wherein a double edged cutting blade may be differently adjusted, so that both edges may be utilized, or only one as preferred, or may be positioned for sharpening. Patent 1707154. Abraham Zilbersher.

Hardware and Tools

Modeling Tool—Which is more or less pointed and flexible, for molding flowers or other articles, whereby a pair of prongs will produce grooves or beads by varying the tension on the tool. Patent 1703785. Annette Shuttleworth.

Boiler-Maker's Tool—Which is adapted for use with pneumatic hammers or like power devices to simultaneously flare and set on the end of a flue tube in a locomotive engine. Patent 1707124. Harry A. Lacerda.

Automatic Feed for Portable Drills—Designed to permit of its operation in inaccessible places and where the ordinary form of ratchet drill could not be used due to the inability to rock the operating handle. Patent 1705384. Andrew J. Wikander.

Nail-Stripping Device—Adapted to be worn in position for use, without interference with the workman's movement, and holding a mass of nails for convenient removal, one or more at a time as desired. Patent 1705435. Barton O. Wooster.

Faucet—In which a rubber valve is moved toward or away from the valve seat, novel means being provided for rigidly holding the valve against lateral movement, thus increasing its life. Patent 1705404. Samuel L. Hedberg.

Hand-Operated Latch Needle—Comprising a handle, a latch needle, and spring means adapted to be flexed for guiding and limiting the movement of the needle when the latter is projected through a fabric. Patent 1704790. Barton E. Cook.

Twisting Device—In which the body portion comprises two sections hingedly secured together, and in which the handles are secured to one of the sections, thereby providing a device which may be readily opened with one hand, and is convenient to handle when working in inconvenient places. The inventor has been granted two patents, 1705369 and 1705411. William J. Leach.

Union Coupling—For detachably connecting adjacent ends of pipes so that a fluid tight connection may be established, without any necessity for compressible packing between the separable members. Patent 1707087. Wilber R. Little.

Heating and Lighting

Grate—Having a plurality of parallel webs spaced apart so that ashes may drop between, said webs providing a plurality of points of support for independent removable fuel-supporting elements. Patent 1703748. Herbert F. Porter.

Heat Control for Cooking Devices—Automatically operable to modify heat, by reducing the temperature at a predetermined time after the material to be cooked attains a certain temperature, and subsequently discontinuing the heat. Patent 1702480. John F. Newsom.

Dehydrating Apparatus—Having a curing compartment at the bottom, and drying compartment above, and open to the air in the housing, the greater portion of heat being directed to the curing chamber. Patent 1704912. Martha E. Bussler.

Water Heater—In which the heating coils can be readily applied or removed without the necessity of uncoupling the steam supply pipes, and when applied will provide a steam-tight connection. Patent 1705382. John A. Tyler.

Illuminating Device—Having a plurality of rows of lamps arranged on a rotatable table, disposed in stepped relation, so that the illumination will cover a considerable area without concentrating on a particular spot. Patent 1707171. Thomas O. Moore.

Machines and Mechanical Devices

Cotton Gin—In the form of an attachment for air blast cotton gins, which will co-operate with the air nozzle to clear the same of all foreign matter, throughout the ginning operations. Patent 1703002. Joseph L. Hart.

Well Barrel—So constructed that it will operate as a gas trap permitting fluid to run in and prevent gas from working on the valves, and will separate sand from the oil. Patent 1703036. Charles Heath.

Smokehouse—Having electrically operated means for imparting rotary motion to a frame or basket supporting meat to be smoked, the circuit being controlled only by securely closing the doors. Patent 1704650. Leo Brand.

Motorized Handsaw—Of simple and practical construction, durable and efficient in use, yet relatively of light weight, may be manually manipulated and operated by steam or other motive fluid. Patent 1704641. Frank L. Weed.

Valve Construction Controlling the Operation of Grease Dispensers—Having a piston adapted to be operated by compressed air, and in which an exhaust valve and an inlet valve for the compressed air are automatically controlled. Patent 1704596. George Emmert.

Automatic Control Mechanism for Drilling Rigs—Readily applied to standard drilling rigs and operating automatically to discontinue operation of the prime mover, whether steam or gas engine, immediately upon the belt becoming untrained from the band wheel. Patent 1704464. Floyd M. Detwiler.

Wire-Winding Machine—A hand operated machine, with automatic feeding and tensioning for spirally applying wire to a spool, particularly adapted for winding tuning coils, as used in radio apparatus. Patent 1704166. Vincent Calabrese.

Putty Mixing and Conditioning Machine—Which thoroughly kneads and mixes the putty so as to properly condition the same, and dispenses the putty in desired cut-off quantities. Patent 1706291. Frank F. Hayes.

Dispensing Cabinet—Of the self-serving type, delivering a single package, such as cigarettes, and actuating a signal to attract the clerk's attention so that he may remove the purchase price. Patent 1706298. Edwin B. Jelks and Joseph W. Harner.

Rotary Die Press—Especially designed for cutting or embossing heavy stock, such as cardboard, in which one of the die supports is reciprocatory, and the stock support is of the multifaced rotary type. Patent 1706319. Morris Oxenhandler.

Method and Means for Pitting Fruit—Such as prunes, peaches, apricots, dates or the like, by the use of compressed air or steam, and causing the pulp and pits to be separately directed to suitable receptacles. Patent 1706322. John Ramslie.

Conveying and Measuring Apparatus—Designed to effect a uniform feed for granular or pulverulent material, including a screw and housing therefor, working without danger of the material flooding or accelerating its rate of feed. Patent 1706292. Arthur W. Hayman.

Stapling Machine—Of the portable type, which includes means for cutting staple blanks from a strip of material, and driving the formed staples by means of a spring-actuated trip plunger. Patent 1705819. Alexander Z. Kruse.

Apparatus for Fastening Pail Covers—Comprising a supporting base and a movable mounting for the crimping mechanism, which permits swinging the mechanism, to one side, before placing the pail upon the base. Patent 1706299. Smith M. Johnson.

Stamping Machine—A stencilling device in the form of a cylinder, in which a plurality of pads are associated, adapted to be revolved over a roadbed for printing indicia readable by tourists. Patent 1707149. Henry G. Stamper.

Conveyer Chain—Particularly adapted for use on automatic or semi-automatic machines, the article-supporting members being connected to a chain in such manner as to maintain the centers properly spaced. Patent 1707088. Frank J. Lynch.

Envelope-Feeding Apparatus for Typewriters—Which will accommodate any ordinary sized envelope, and will feed the envelopes one at a time to the typewriter, without the operator handling them until the addressing operation is completed. Patent 1707080. Harold L. Dyer.

Hydraulic Washing Machine—Which may be connected by a hose to a house faucet for operating the machine and cleansing the clothes, the operating parts are protected against the clothing becoming entangled therewith. Patent 1707083. Harley A. W. Howdott.

Attachment for Grain Purifiers—A suction device which may be readily installed in connection with various forms and sizes of grain purifiers, for withdrawing specks and other forms of inpurity from the grain. Patent 1706800. Thomas A. McWilliams, Omer C. Parman and Albert R. Overall.

Mold—More particularly for casting double walled pistons, easily assembled and disassembled and from which the cast piston may be readily removed. Patent 1705905. Lewis R. Davis.

Medical Devices

Eye-Exercising Apparatus—Designed to continuously move a plurality of objects toward the eyes of the patient, followed by a disappearing movement so that the eye muscles will be subjected to exercising motions. Patent 1702700. Earl L. Martin.

Mandrel—Which embodies means for positively clamping the mandrel in the clutch, thus facilitating the dentist's work, insuring the even running of the disk, and eliminating injury to the patient. Patent 1705440. Thomas D. Craig.

Musical Devices

Valve—For wind instruments, particularly horns, the construction being such that co-operation of several valves may be obtained whereby they may be applied to a horn or other musical instruments. Patent 1703411. Theodore A. Steinmetz.

Combined Magnet and Valve—A relatively small instrument combining a valve and an electro-magnet, for controlling the passage of air to the pipes of a pipe organ, disassembly for repair is readily accomplished. Patent 1703771. August A. Klann.

Bridle Strap for Piano Actions—Which embodies in combination with a tape, a clip adapted to embrace the catcher head and its shank with such security as to prevent its accidental disengagement. Patent 1703298. Hiram E. Chute.

Plumbing and Fixtures

Toilet-Fixture Support—For sinks, washstands, water closets, etc., which may be quickly enstalled and embodies a support for the flush valve sleeve carried and supported directly from the wall plate. Patent 1706285. Richard T. Frye.

Railways and Their Accessories

Emergency Check Valve — For automatically closing a valve in the main turret of a locomotive, in the event of a wreck, to prevent steam escaping and the scalding of the engine crew. Patent 1703801. Lewis I. Ve Verka.

Train Signal—Which affords facilities for causing a signal to be actuated in the engine cab whereby the engineer will be apprised of an obstruction in advance of the engine. Patent 1703055. Walter Bourg.

Pertaining to Recreation

Golf Instructing Apparatus—In the form of a belt, having mechanism therein for momentarily restraining the pivoting of the body relative to the arms in the downward swing, thus preventing a tendency to mistime the ball. Patent 1703375. Andrew C. Volk.

Punching Bag—With a rocking support and a compressible spring, whereby a lateral movement will cause a compression so that when the bag is released it will automatically return to its original position. Patent 1703012. Denis McNamara.

Fishing Tackle—Constructed of strands of spring wire fashioned to provide arms that project at right angles for supporting hooks, so that they will not become tangled with the main line. Patent 1702417. Alexander T. Sandbo.

Game Apparatus—Comprising a gameboard and a pair of chance-controlled longitudinally movable tokens, one being rotatable about its axis, and means operating independently to control the movement of the tokens. Patent 1704619. Harvey C. Markman.

Swing—Of simple construction and portable nature, may be easily assembled, and will provide a rigidly interlocking frame of the "knock-down" type, without the use of bolts or other fastenings. Patent 1707167. Aud R. Marshall.

Pertaining to Vehicles

Tire - Pump - Connecting Device—For connecting an air hose with a tire valve, whereby the connection may be established in a minimum time without the use of tools and will be firm. Patent 1702970. Fred I. Jaden.

Vehicle Roof—Capable of being moved to open position so that a substantially unobstructed view may be obtained through the vehicle tops, yet can be easily closed and effectively sealed to prevent leakage. Patent 1703395. Herman House.

Automobile Clutch - Operating Mechanism—Whereby great power is accomplished through a minimum of energy applied to the transforming of a partial rotary movement into a longitudinal movement, thereby preventing stripping of the gears in shifting. Patent 1704602. Emmet T. Harney.

Signal Device for Automobiles—Having mechanical means, actuated by the engine, for oscillating a warning signal so indicating in which direction the automobile is to turn, and for illuminating the license plate. Patent 1703957. George H. Sautier.

Tire-Rim-Contracting Device—Which will hold the rim in contracted condition while the tire is being removed and replaced, and until released to return to its normal condition. Patent 1700719. Samuel H. Savage.

Accelerator—An attachment encluding a base and a pedal rockably adapted to engage the accelerating means of an automobile; may be easily emplaced in the car by the owner. Patent 1700643. Carol Nordell.

Weather Strip—Adapted for use on automobiles, windows, having substantially semi-frictionless portions, so as to allow the glass to slide reasonably free, and a resilient portion which tends to hold the glass firmly, and reduces the tendency of rattle or vibration. The inventor has been granted two patents, 1704997 and 1704998. Arthur H. Atxenhoffer.

Automobile Lock—For use in conjunction with a driven part of the motor or engine to prevent their being operated, and the car stolen by an unscrupulous person. Patent 1706352. Justin de Serguirant.

Quick-Detachable Appliance—Which may be easily applied to a threaded tire valve stem extending through a bore in the rim of a vehicle wheel, to effectively hold the stem against withdrawal. Patent 1706317. George W. Oakes.

Truck Tank for Liquids—Wherein a number of independent containers are provided in a single tank and associated with means whereby the contents of the various containers may be heated. Patent 1705649. Carlyle H. Scott.

Lubricator Indicator—Wherein oil from the crank case of a motor vehicle can be elevated, by means of a pump, to a sight glass, and a specimen displayed for determining the condition. Patent 1706001. Philip Shapiro.

Decorative Wreath for Automobile Headlights—Which may be conveniently attached to or removed from the usual automobile headlight casing, and when viewed from the front will conceal the casing, but leave the lens exposed. Patent 1707127. Burns H. Marshall.

Sanding Machine—Which will normally be inactive, but will provide a convenient means for allowing the driver to spread sand in front of the wheels to prevent skidding on slippery roads. Patent 1705878. John Robbins.

Smoker's Article—Adapted for supporting a package of matches, and cigarettes or cigars adjacent the steering wheel, and an accessory for extinguishing the cigars or cigarettes preparatory to discarding them. Patent 1705898. Kingsley W. Cannon and Frederick G. E. Lange.

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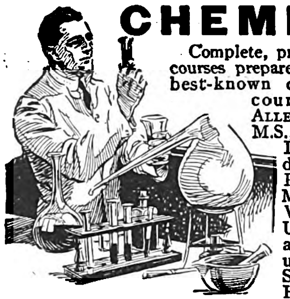

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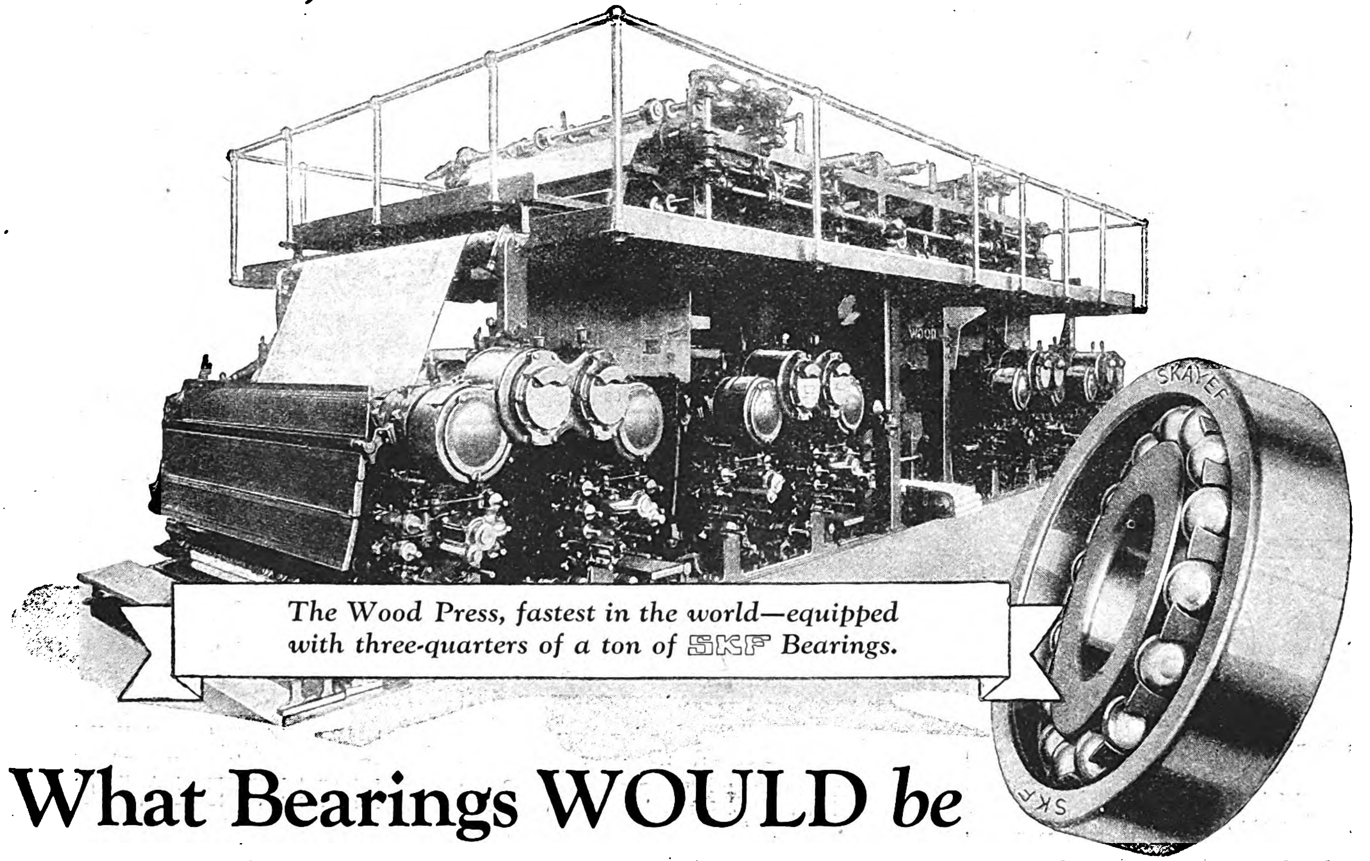

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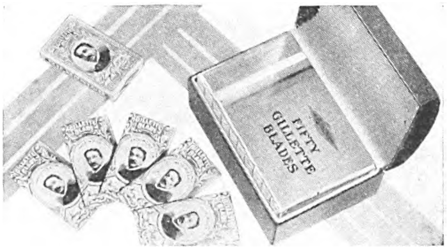

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COVER

Our cover this month shows a curious mingling of the old and the new. Here our artist, Howard V. Brown, shows native helpers putting together statues which had been broken purposely and in anger, as described on page 522. We recognize at once an American differential hoisting block and an American winch.

Knock Waste
Out of Your Plant

It is a fight to the finish—Industry *vs.* Waste—but Industry now knows how to win.

Power relieved from friction by Timken Bearings, puts a powerful punch into production.

—*And down goes Waste for the count.* Timken Bearings put fighting machines into every field, free from high maintenance, premature wear, misalignment and breakdowns.

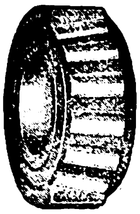
With their compact radial-thrust ability, saving of power and lubricant, increase and betterment of production, extension of machine life—Timken Bearings reach into every phase of Industry and express today's demand in modern machine design.

Exclusive results are found in this exclusive Timken combination of features—Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken electric steel.

Wherever wheels and shafts turn "Timken-Equipped" champions your cause against Waste in every class of service from feather-weight to heavy-weight. Use it as your guide.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**



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Looking Ahead *With the* Editor

Of Course It's Safe

LADY MARY HEATH has written for us an illuminating article on aviation safety. In her article, which is to be published soon, she points out that, while as a rule people are inclined to be hysterically impressed by news of an air tragedy, the percentage of accidents is very low and those that occur are usually attributable to carelessness or the desire to stunt. Further, she tells of certain safety devices needed and explains why she believes in the great future of aviation.

O_3

THIS ozone, this "150 percent oxygen" in the earth's atmosphere that prevents a life-exterminating potency of ultra-violet rays from reaching us—just what is it? How identified? How produced in the atmosphere? How obtained in the laboratory? Heavier than air, how does it remain as a layer far above the earth? How deep is the layer? A significant article in an early issue answers these and other questions.

"Carretera al Mar"

RATHER incredible that the building of a highway should become a burning national passion, isn't it? Yet that is what happened in a department of Colombia. Its capital, with 100,000 people, an ideal climate, a wealth of natural resources, a tremendous production of coffee and other commodities, was almost isolated by mountains. Read in these pages soon the story of the 255-mile road they are building to the sea.

Neglected Mushrooms

WHO does not like mushrooms? Very few people, indeed, of those fortunate in being near a source of supply. But there are others who like them, too, yet live far from mushroom markets and are afraid the mushrooms in the fields and woods about them are poisonous. In a coming article an authority on the subject will describe the edible varieties and tell how you may gather literally hundreds of pounds of them.

Over the Andes and Beyond

THE inauguration recently of air mail lines from the United States to South America is an event of great importance in aviation. Besides the service they will render, they will serve as a closer tie between the nations and will foster a spirit of mutual friendship. But, as explained in an article now ready for release, aviation is not at all new in South America. Look for this surprising Latin-American aviation-travel story.

Every Issue Fully Illustrated

¶ *To keep abreast of the times, you must keep pace with the advances of science. For only four dollars, the* SCIENTIFIC AMERICAN *will keep you informed of the latest happenings in the world of science for a period of twelve months.*

Among Our Contributors

Walter Miles

DR. MILES is well known for his many notable researches in psychology and physiology. Since achieving his doctorate at Iowa, he has taught in several large institutions of learning, was for years in the research laboratory of Carnegie Institution, and is now Professor of Experimental Psychology at Stanford University. He frequently collaborates in experiments with Mrs. Miles, also a Ph.D.

Paul R. Heyl

THOSE of our readers who have not seen Dr. Heyl's photograph, possibly picture him as some sort of myth—so rare is the really great scientist with the happy faculty, possessed by Dr. Heyl, of describing a most abstruse scientific subject, experiment, or phenomenon in such a manner that the layman reads the article avidly. But Dr. Heyl is far from being a mythical person—he is a very human person as well as a scientist.

Ernest N. Patty

DR. PATTY has studied at first hand the geology of the vast wilderness of Alaska which is so little understood by the public and for which a great future may be predicted despite its sub-arctic location. His studies may lead to a better understanding of this, our last frontier, its potentialities and its resources. Dr. Patty is Dean of the Alaska Agricultural College and School of Mines located at College, Alaska.

Karl L. Kithil

MR. KITHIL is a consulting engineer of note in a wide field of mining, rare earths, rare metal ores, determination of sub-structural earth conditions, et cetera. An interesting research recently carried out by him was the determination of the magnitude and effect of vibrations in buildings caused by blasting operations a mile distant.

Francis P. Mann

FOR years Mr. Mann has resided in Paris, has kept in touch with the doings on the Continent, and has contributed many articles to our pages. This month, he tells of the French registration of new paintings, a procedure designed to obviate, in future, controversies relative to their authenticity.

FIRST IN WESTERN AVIATION

Aircraft Industry

Enjoys Unique Advantages *in* Los Angeles County

32% of the aviation activity in the entire United States centers in Southern California. (U. S. Dept. Commerce)

Available investigations by meteorologists, industrial engineers and aviation authorities show conclusively that atmospheric, geographic, industrial and other conditions here are particularly favorable to aviation industry.

12 major factories are now manufacturing airplanes and aircraft motors here. Highest type, experienced, skilled labor is available; 20% of all licensed pilots; 20% of all identified aircraft; 25% of all aviation schools in the United States are in Southern California.

There are 50 or more airports and landing fields in Los Angeles County alone. (See graphic map at left).

Climatic and other conditions are bound to make this the aviation capital of America. The advantages of this immediate territory are not to be had elsewhere.

Complete detailed surveys and information promptly furnished upon request to the Industrial Department,

Industry Here Enjoys:

Freedom from Labor Trouble

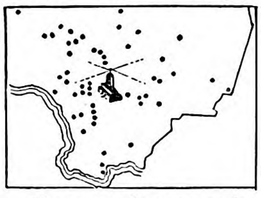
Mild Climate

Cheap and Abundant Power and Water
Cheap Fuel

Low Building Costs

Largest Western Market

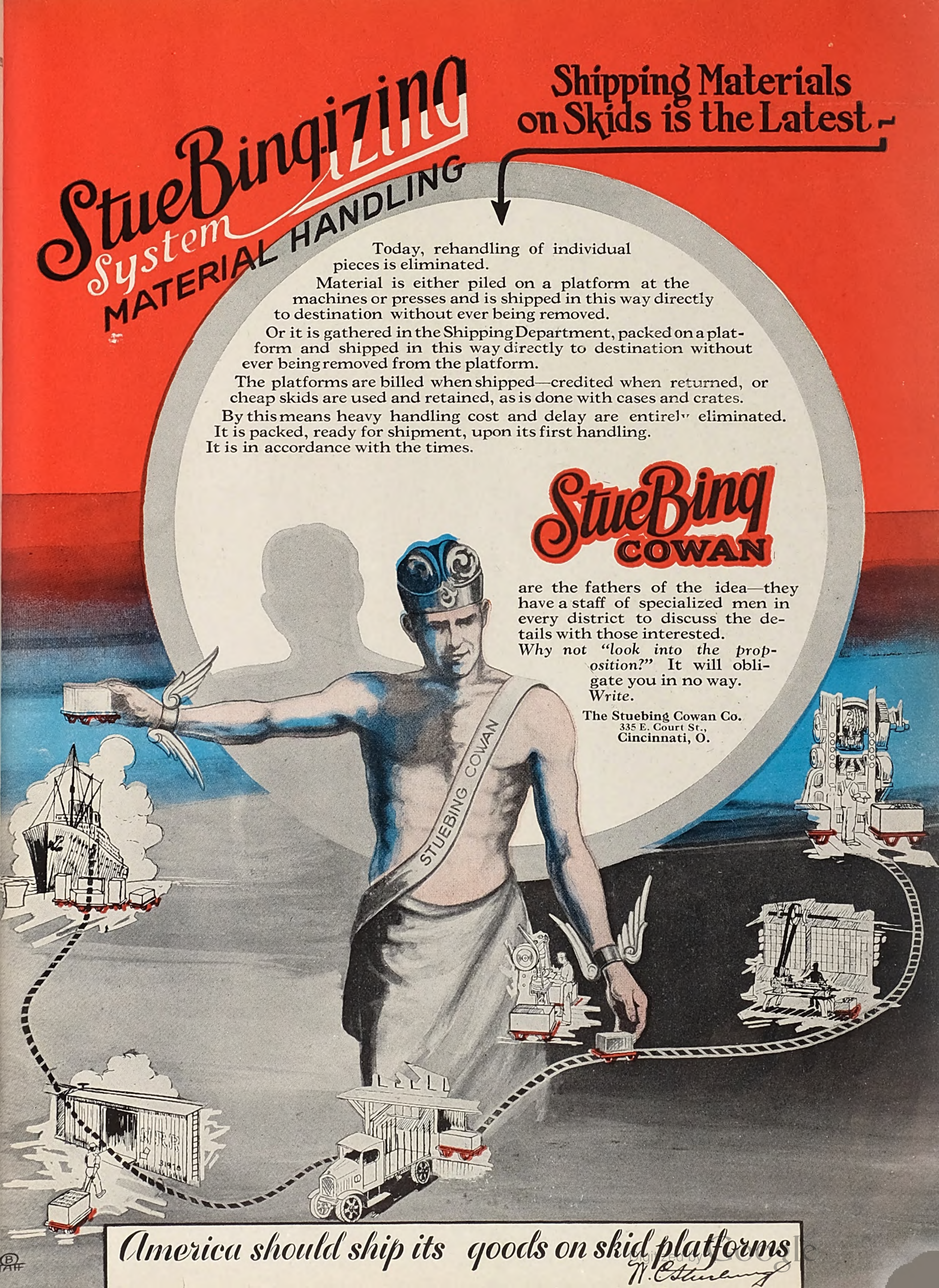
Splendid Export, Rail and Highway Outlets



Above map shows part of Los Angeles County. Every dot represents an airport or landing field.

Los Angeles
Chamber of Commerce

Air-minded
Los Angeles County



StueBingizing System MATERIAL HANDLING

Shipping Materials on Skids is the Latest

Today, rehandling of individual pieces is eliminated.

Material is either piled on a platform at the machines or presses and is shipped in this way directly to destination without ever being removed.

Or it is gathered in the Shipping Department, packed on a platform and shipped in this way directly to destination without ever being removed from the platform.

The platforms are billed when shipped—credited when returned, or cheap skids are used and retained, as is done with cases and crates.

By this means heavy handling cost and delay are entirely eliminated. It is packed, ready for shipment, upon its first handling. It is in accordance with the times.

StueBing COWAN are the fathers of the idea—they have a staff of specialized men in every district to discuss the details with those interested. *Why not "look into the proposition?"* It will obligate you in no way. *Write.*

The Stuebing Cowan Co.
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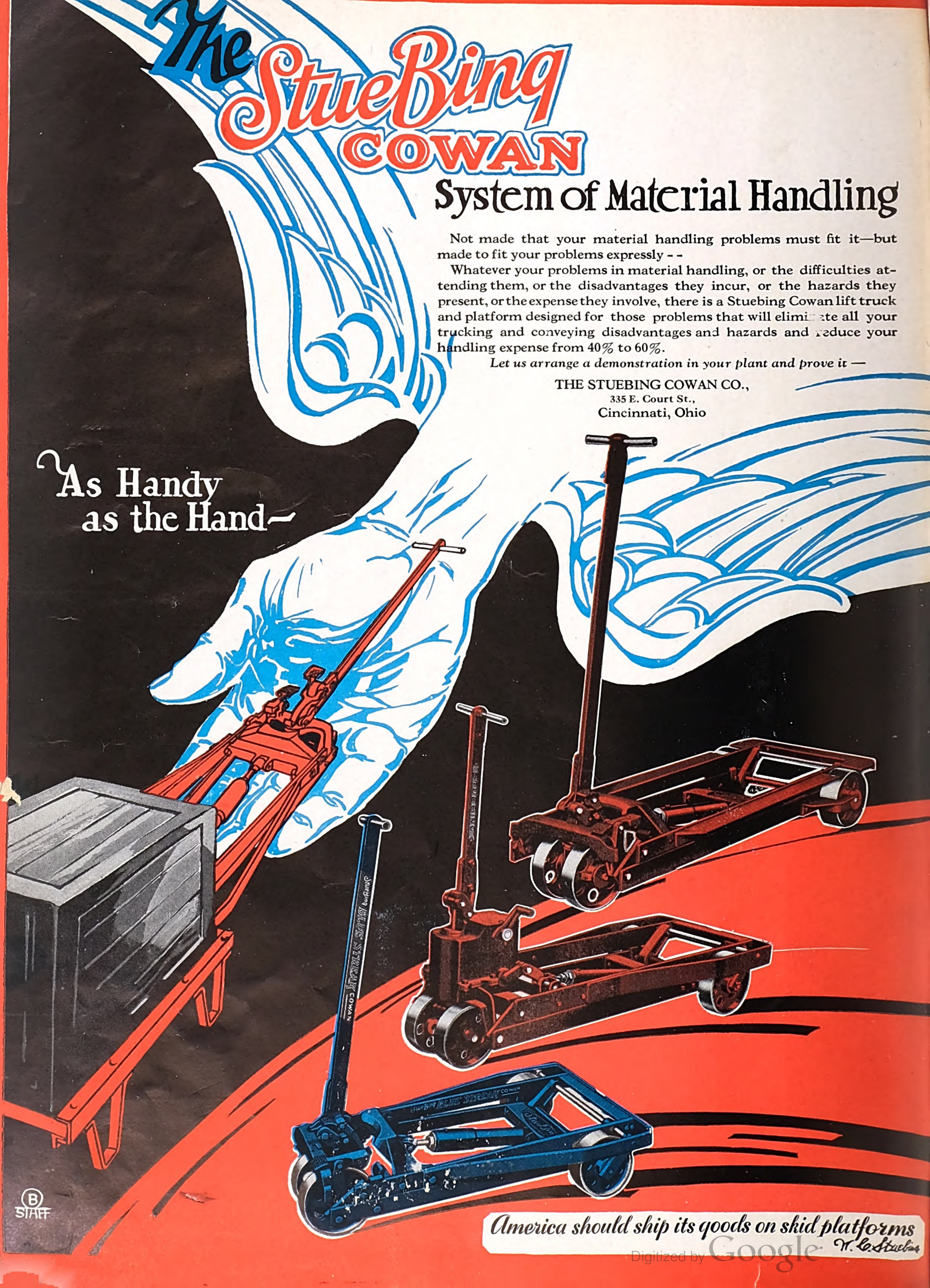
Cincinnati, O.


"As Handy as the Hand—
Stuebing BLUE STREAK COWAN
America should ship its goods on skid platforms
W. C. Stuebing
STAFF

The Stuebing Cowan System of Material Handling

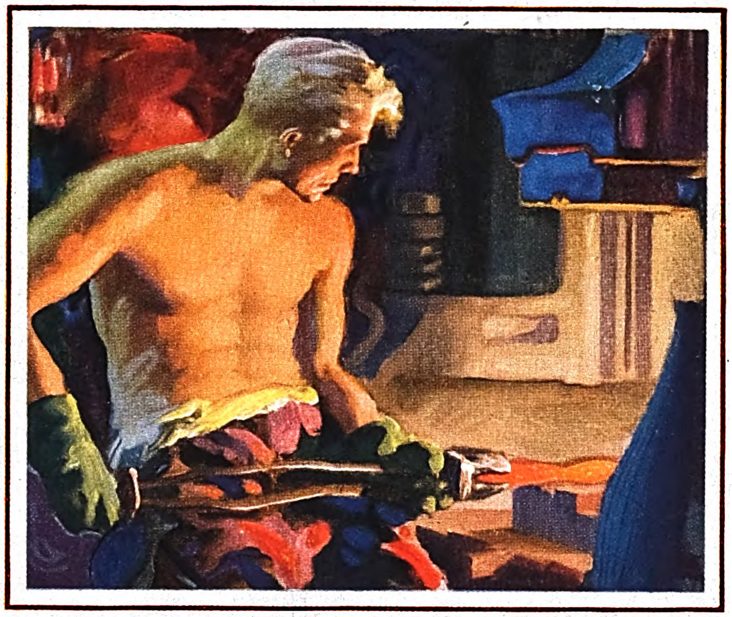
Not made that your material handling problems must fit it—but made to fit your problems expressly - -

Whatever your problems in material handling, or the difficulties attending them, or the disadvantages they incur, or the hazards they present, or the expense they involve, there is a Stuebing Cowan lift truck and platform designed for those problems that will eliminate all your trucking and conveying disadvantages and hazards and reduce your handling expense from 40% to 60%.

Let us arrange a demonstration in your plant and prove it —

THE STUEBING COWAN CO.,
335 E. Court St.,
Cincinnati, Ohio

PACKARD



Only where talent and industry are rewarded, can the highest standard of quality craftsmanship be maintained

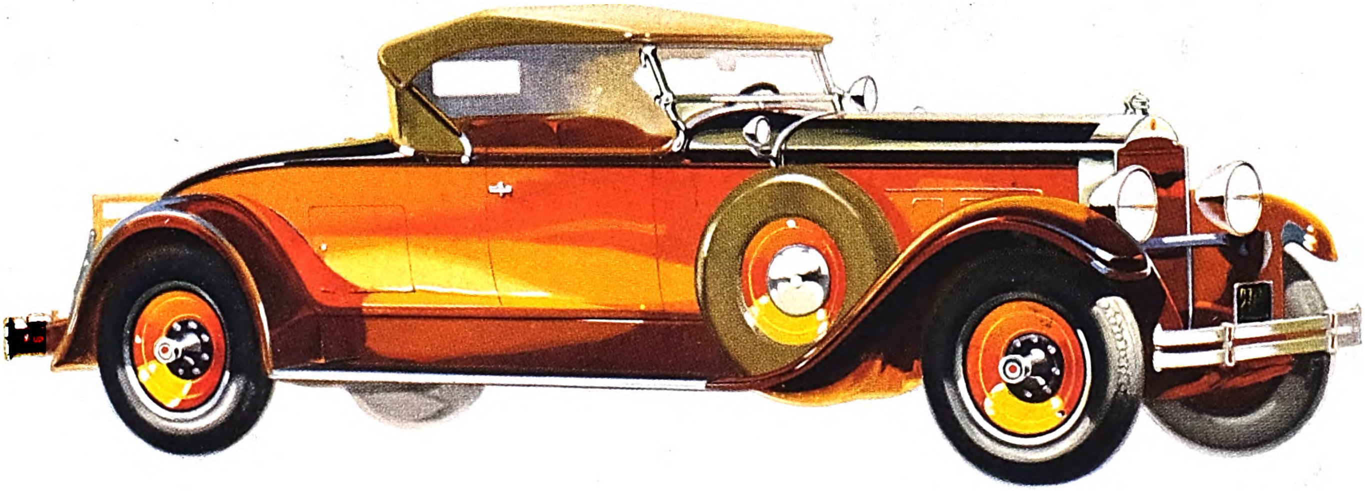
Packard men are carefully chosen. Their native skill is enhanced by Packard training. Inspection is rigid, but supervision is friendly and helpful. Initiative is fostered—aptitude rewarded. Merit may always be sure of recognition.

The human element is all-important. No other factor—design, engineering, methods or materials—overshadows craftsmanship in its contribution to the high quality of Packard cars.

And so at Packard there has been developed an organization of automobile artisans, schooled to one standard of quality workmanship—the highest.

Thousands of Packard craftsmen have been at their duties for five and more years—hundreds upwards of a decade. Their loyal and intelligent co-operation has helped measurably to build Packard's priceless reputation for outstanding leadership in the fine car field.

ASK THE MAN WHO OWNS ONE



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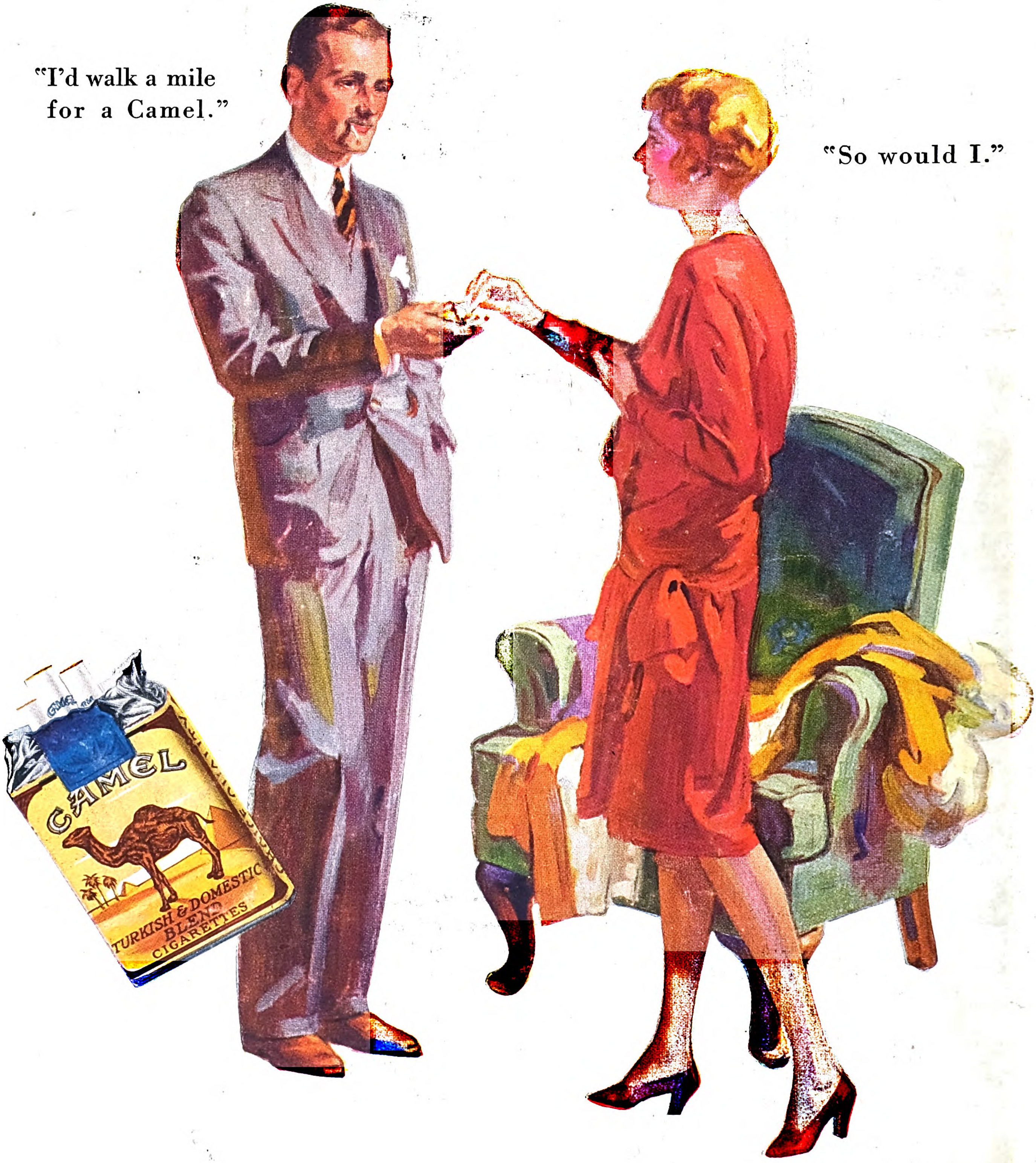
UNANIMOUS

"I'd walk a mile for a Camel."


CAMEL
TURKISH & DOMESTIC BLEND CIGARETTES

"So would I."

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